

**FSU Meteorology**

**INTEX-NA Web Site**

<http://bertha.met.fsu.edu/INTEX/>



## NASA INTEX-NA 2004

### Florida State University

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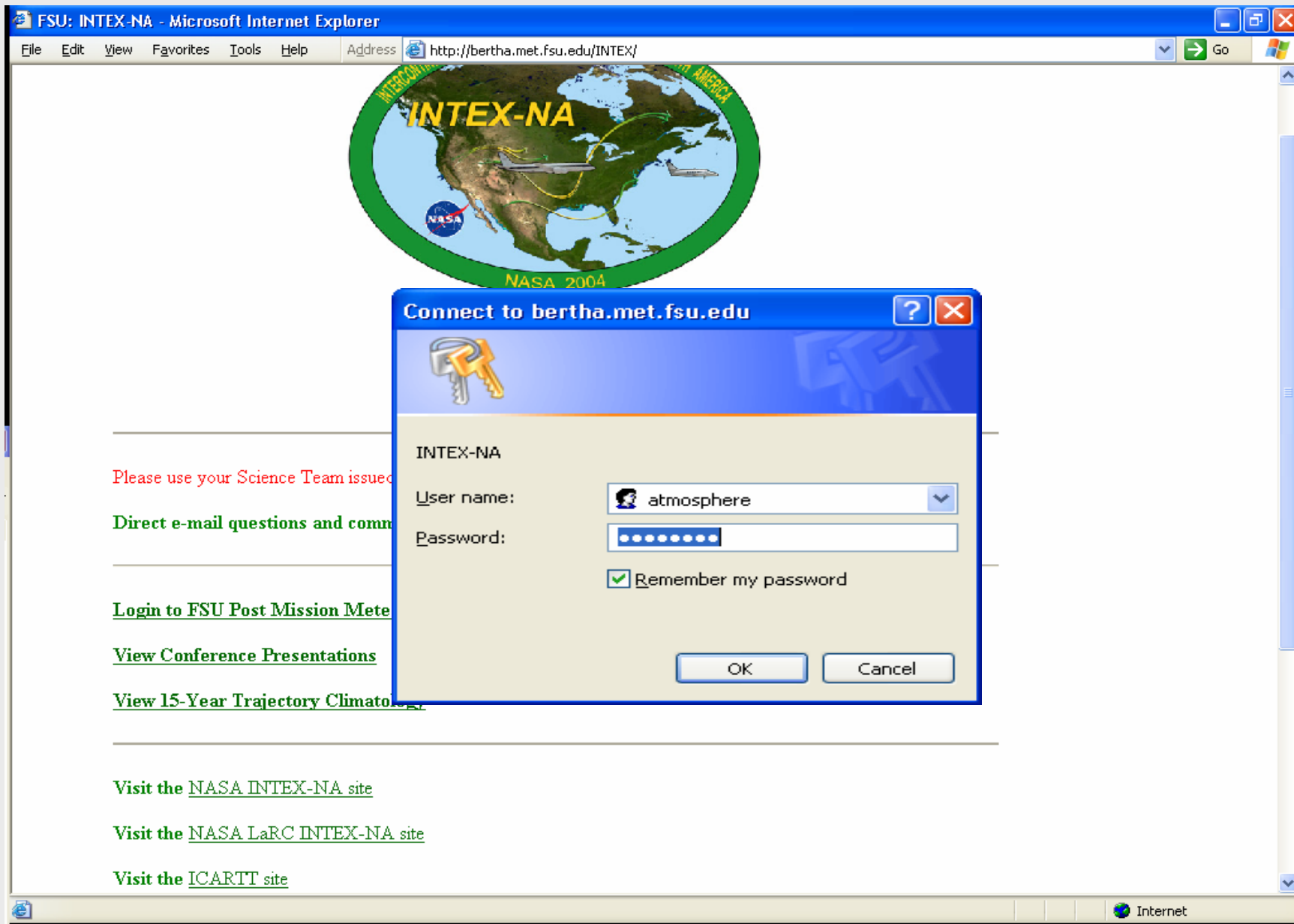
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Visit the [NASA LaRC INTEX-NA site](#)

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atmosphere

airborne



## NASA INTEX-NA 2004

### Florida State University

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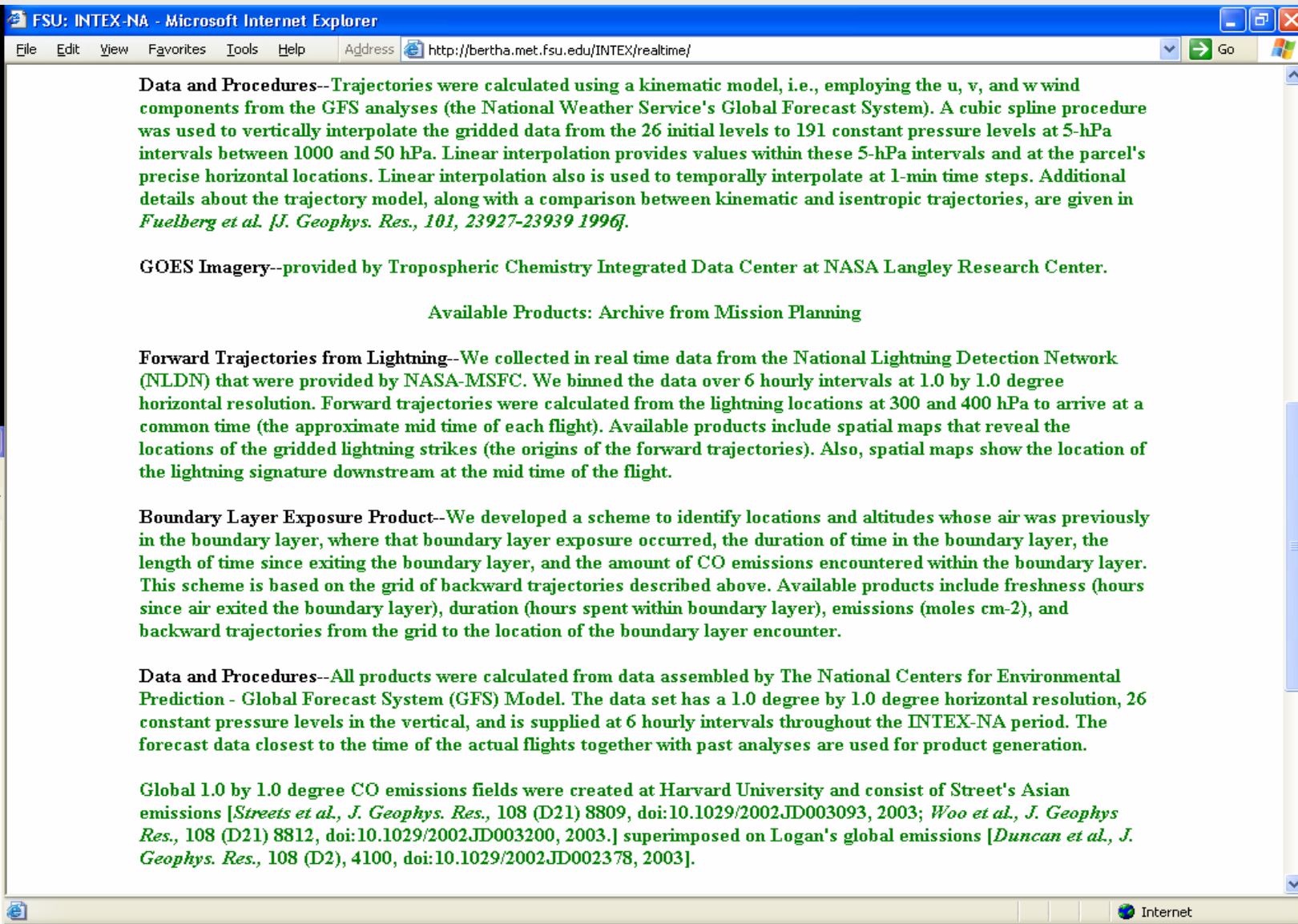
#### Available Products: Post Mission Reanalysis

**10-day Backward Trajectories**--Trajectories start at 1-minute intervals throughout the duration of each DC-8 flight. Available products include trajectories calculated from exact flight positions, as well as trajectories arriving at constant pressure levels (300, 500, 700 and 850 hPa) along the flight path.

**10-day Forward Trajectories**--Trajectories start at 1-minute intervals throughout the duration of select lagrangian cases. Available products include trajectories calculated from exact flight positions, as well as trajectories starting at constant pressure levels (300, 500, 700 and 850 hPa) along the flight path.

Arrows indicate trajectory positions at daily intervals. Red asterisks mark final trajectory positions at the end of 10 days, while red crosses denote trajectories that reach the domain boundary prior to the end of the 10 day period.

To facilitate easy viewing of a specific flight segment, 5 vertical layers were selected (surface to 850 hPa, 850 to 700, 700 to 500, 500 to 300, and above 300 hPa). A new flight leg was defined each time the aircraft passed into a different layer. Thus, each flight consists of approximately 50 legs. Users can select the leg they wish to view. Each selected leg also can be viewed as a trajectory plot ranging from 2 days to 10 days in duration.



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This scheme is based on the grid of backward trajectories described above. Available products include freshness (hours since air exited the boundary layer), duration (hours spent within boundary layer), emissions (moles cm<sup>-2</sup>), and backward trajectories from the grid to the location of the boundary layer encounter.

**Data and Procedures**--All products were calculated from data assembled by The National Centers for Environmental Prediction - Global Forecast System (GFS) Model. The data set has a 1.0 degree by 1.0 degree horizontal resolution, 26 constant pressure levels in the vertical, and is supplied at 6 hourly intervals throughout the INTEX-NA period. The forecast data closest to the time of the actual flights together with past analyses are used for product generation.

Global 1.0 by 1.0 degree CO emissions fields were created at Harvard University and consist of Street's Asian emissions [*Streets et al., J. Geophys. Res.*, 108 (D21) 8809, doi:10.1029/2002JD003093, 2003; *Woo et al., J. Geophys. Res.*, 108 (D21) 8812, doi:10.1029/2002JD003200, 2003.] superimposed on Logan's global emissions [*Duncan et al., J. Geophys. Res.*, 108 (D2), 4100, doi:10.1029/2002JD002378, 2003].

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FSU INTEX-NA meteorological and backward trajectory products

Choose Desired DC-8 Flight:

Jul 01, 2004 DC-8 Flight 03

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FSU INTEX-NA forward trajectory products for Lagrangian cases

Choose Desired DC-8 Flight:

Jul 06, 2004 DC-8 Flight 04

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Direct e-mail questions and comments to [mporter@met.fsu.edu](mailto:mporter@met.fsu.edu)

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Global 1.0 by 1.0 degree CO emissions field	Jul 08, 2004	DC-8 Flight 05	university and consist of Street's Asian emissions [Streets et al., J. Geophys. Res., Res., 108 (D21) 8812, doi:10.1029/2002JD003093, 2003; Woo et al., J. Geophys. on Logan's global emissions [Duncan et al., J.
emissions [Streets et al., J. Geophys. Res.,	Jul 10, 2004	DC-8 Flight 06	
Res., 108 (D21) 8812, doi:10.1029/2002JD003093,	Jul 12, 2004	DC-8 Flight 07	
Geophys. Res., 108 (D2), 4100, doi:10.1029/2002JD003093,	Jul 15, 2004	DC-8 Flight 08	
Geophys. Res., 108 (D2), 4100, doi:10.1029/2002JD003093,	Jul 18, 2004	DC-8 Flight 09	

Jul 01, 2004	DC-8 Flight 03
Jul 06, 2004	DC-8 Flight 04
Jul 08, 2004	DC-8 Flight 05
Jul 10, 2004	DC-8 Flight 06
Jul 12, 2004	DC-8 Flight 07
Jul 15, 2004	DC-8 Flight 08
Jul 18, 2004	DC-8 Flight 09
Jul 20, 2004	DC-8 Flight 10
Jul 22, 2004	DC-8 Flight 11
Jul 25, 2004	DC-8 Flight 12
Jul 28, 2004	DC-8 Flight 13
Jul 31, 2004	DC-8 Flight 14
Aug 02, 2004	DC-8 Flight 15
Aug 06, 2004	DC-8 Flight 16
Aug 07, 2004	DC-8 Flight 17
Aug 11, 2004	DC-8 Flight 18
Aug 13, 2004	DC-8 Flight 19
Aug 14, 2004	DC-8 Flight 20
Jul 01, 2004	DC-8 Flight 03

nt:

**Choose Desired DC-8 Flight:**

Jul 06, 2004 DC-8 Flight 04

Direct e-mail questions and comments to [mporter@met.fsu.edu](mailto:mporter@met.fsu.edu)

To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

FLIGHT LEG

Leg 1 ▾

ARRIVAL LEVEL

Flight Track ▾

DURATION

10 days ▾

**MAKE PLOT**

Scroll through legs with

**PREV** & **NEXT**[Flight-time GOES image](#)[Pre-flight MET briefing](#)[Archive of realtime PBL  
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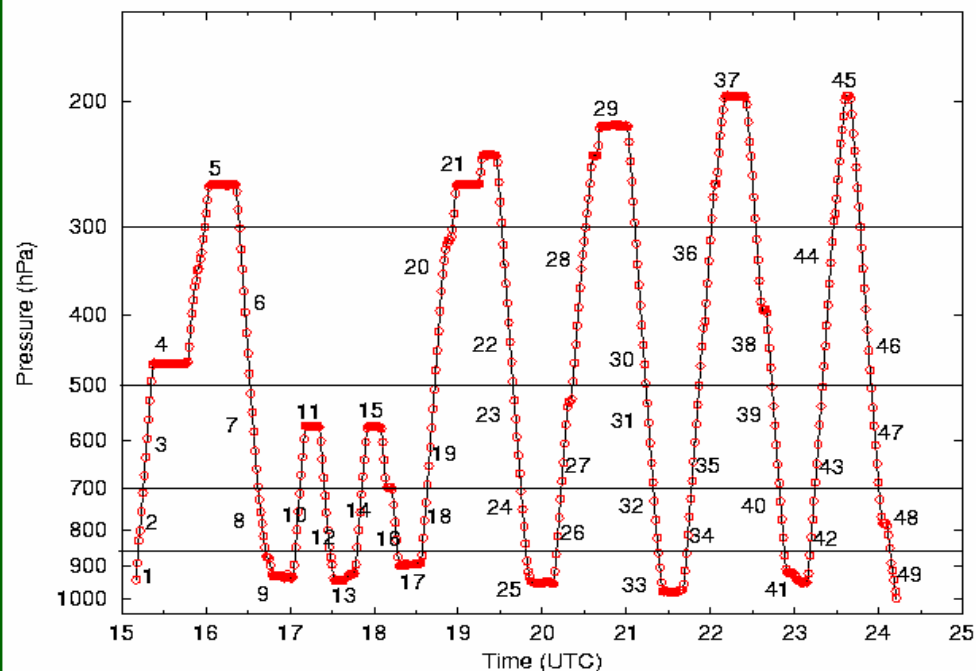
Jump to another flight

Flight 07 - 12 JUL ▾

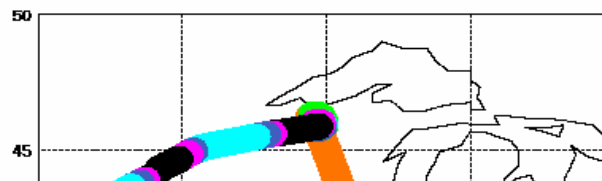
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## INTEX-NA FLIGHT 07

12 JUL 2004



## PATH FOR INTEX-NA FLIGHT ON 12 JUL 2004





To view trajectories, select a [Flight Leg](#), Arrival Level, and Duration, then click on **MAKE PLOT**

FLIGHT LEG

Leg 1

ARRIVAL LEVEL

Flight Track

DURATION

10 days

**MAKE PLOT**

Scroll through legs with

**PREV** & **NEXT**

[Flight-time GOES image](#)

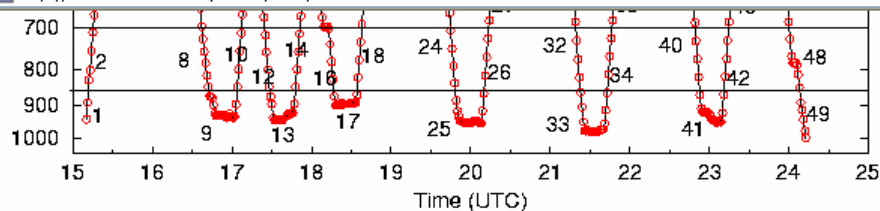
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[Archive of realtime PBL and lightning products](#)

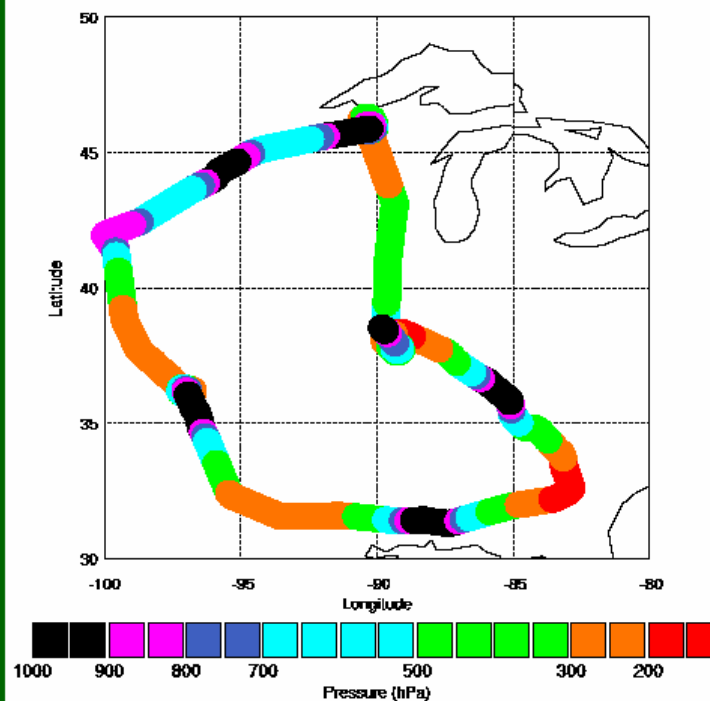
Jump to another flight

Flight 07 - 12 JUL

[MAIN FSU INTEX-NA PAGE](#)



### PATH FOR INTEX-NA FLIGHT ON 12 JUL 2004



To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

FLIGHT LEG

Leg 1

ARRIVAL LEVEL

Flight Track

DURATION

10 days

MAKE PLOT

Scroll through legs with

PREV &amp; NEXT

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and lightning products](#)

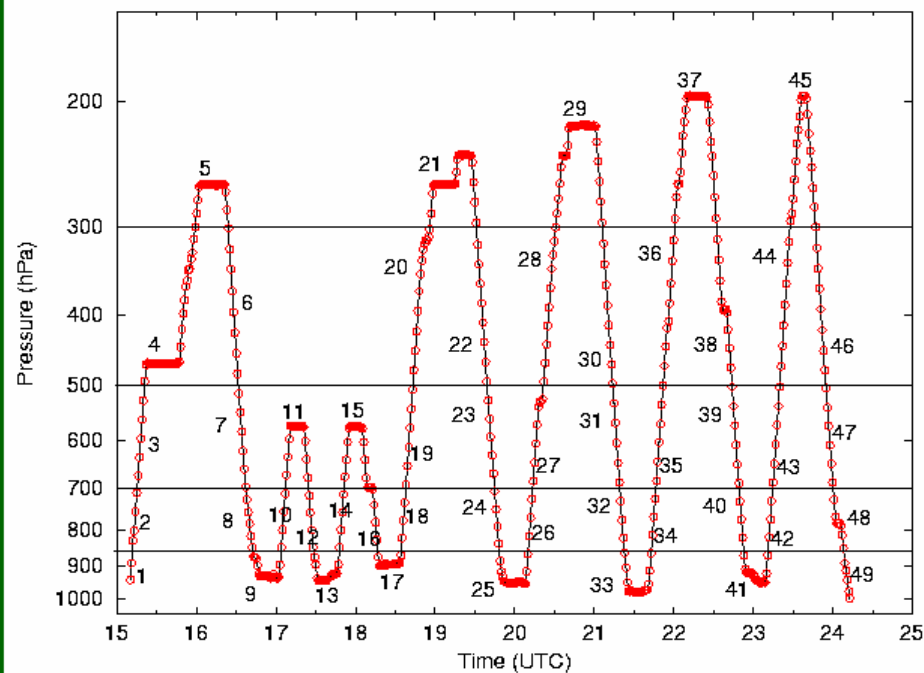
Jump to another flight

Flight 07 - 12 JUL

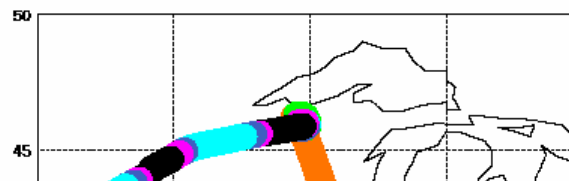
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## INTEX-NA FLIGHT 07

12 JUL 2004



## PATH FOR INTEX-NA FLIGHT ON 12 JUL 2004



To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

## FLIGHT LEG

Leg 1

Leg 2

Leg 3

Leg 4

Leg 5

Leg 6

Leg 7

Leg 8

Leg 9

Leg 10

Leg 11

Leg 12

Leg 13

Leg 14

Leg 15

Leg 16

Leg 17

Leg 18

Leg 19

Leg 20

Leg 21

Leg 22

Leg 23

Leg 24

Leg 25

Leg 26

Leg 27

Leg 28

Leg 29

Leg 30

Scroll

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PRE

EXT

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Jump

flight

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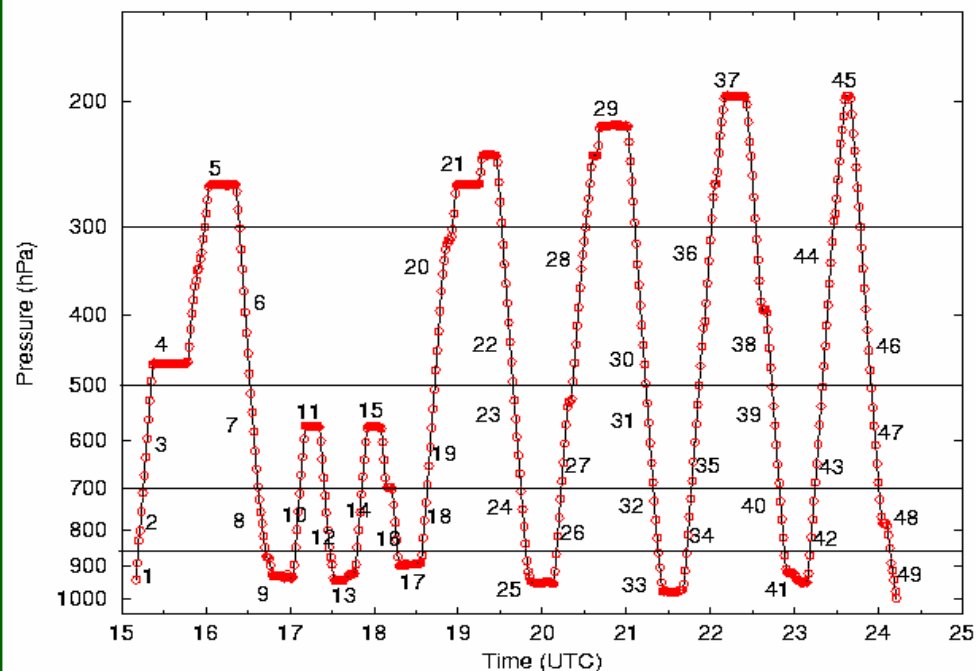
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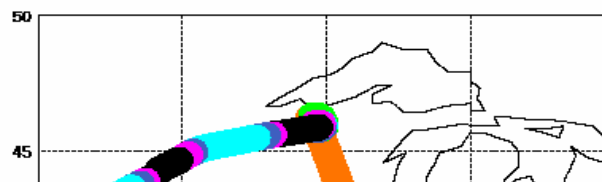
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## INTEX-NA FLIGHT 07

12 JUL 2004



## PATH FOR INTEX-NA FLIGHT ON 12 JUL 2004



To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

FLIGHT LEG

Leg 5

ARRIVAL LEVEL

Flight Track

DURATION

10 days

10 days

7 days

5 days

3 days

Scroll 2 days with

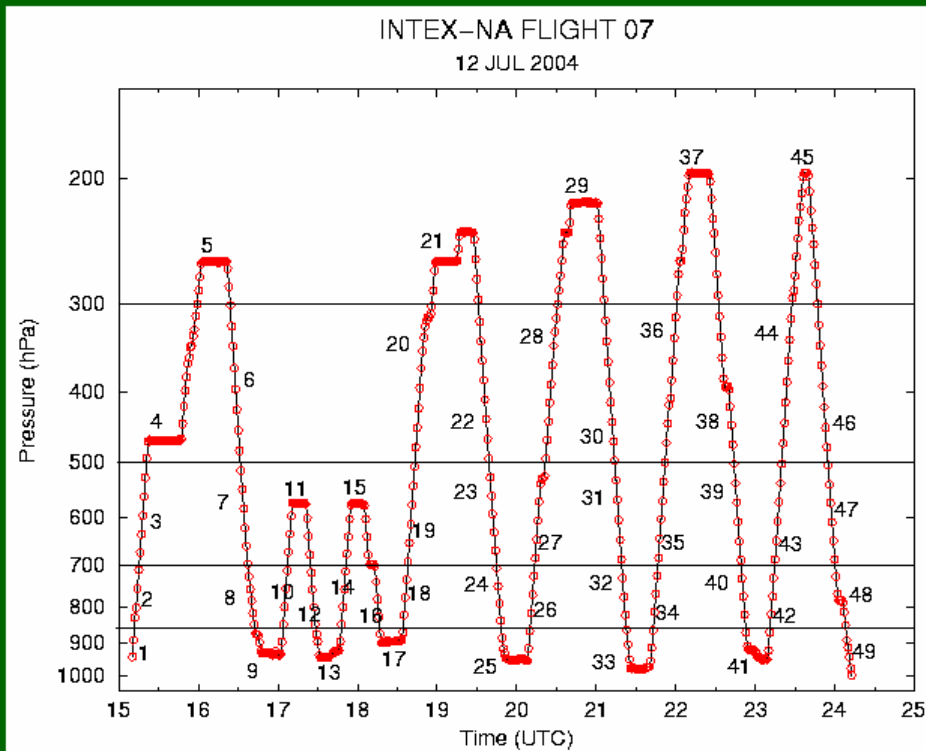
PREV

&amp; NEXT

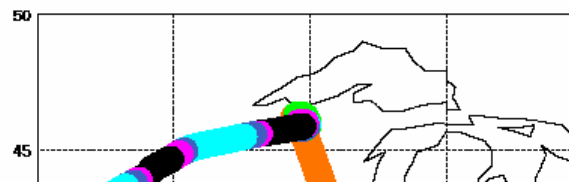
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and lightning products](#)

Jump to another flight

Flight 07 - 12 JUL

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## PATH FOR INTEX-NA FLIGHT ON 12 JUL 2004



To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

FLIGHT LEG

Leg 5 ▾

ARRIVAL LEVEL

Flight Track ▾

DURATION

7 days ▾

**MAKE PLOT**

Scroll through legs with

**PREV** & **NEXT**[Flight-time GOES image](#)[Pre-flight MET briefing](#)[Archive of realtime PBL  
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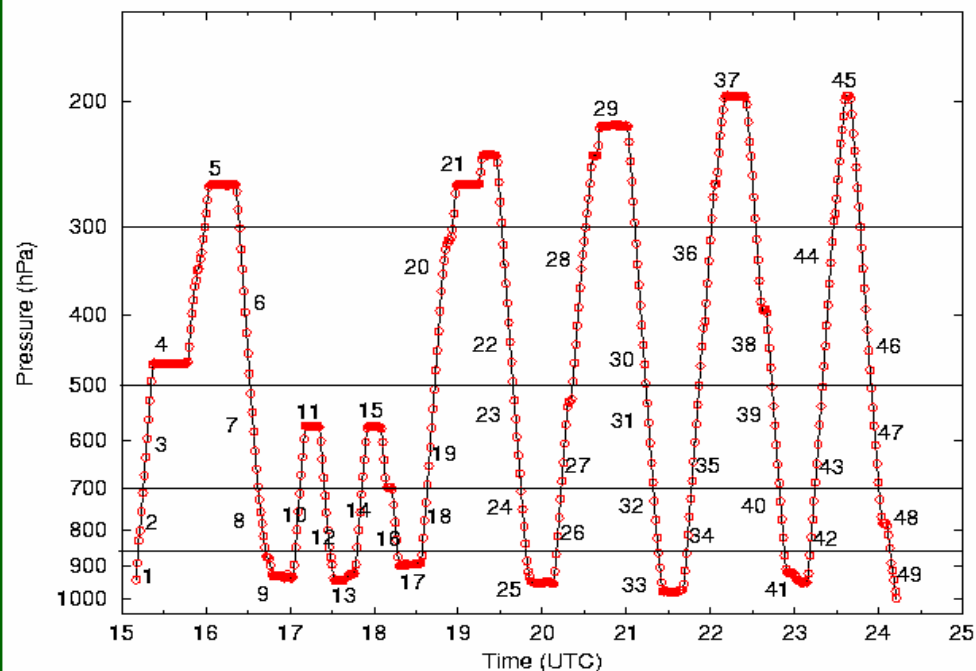
Jump to another flight

Flight 07 - 12 JUL ▾

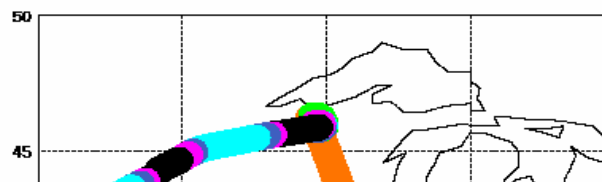
[MAIN FSU INTEX-NA PAGE](#)

## INTEX-NA FLIGHT 07

12 JUL 2004



## PATH FOR INTEX-NA FLIGHT ON 12 JUL 2004



To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

FLIGHT LEG

Leg 5

ARRIVAL LEVEL

Flight Track

DURATION

7 days

MAKE PLOT

Scroll through legs with

PREV

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NEXT

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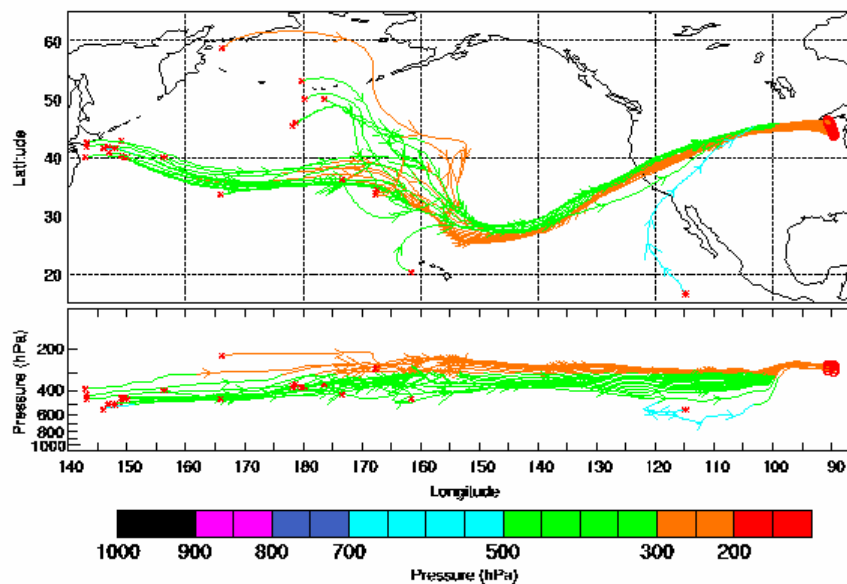
Jump to another flight

Flight 07 - 12 JUL

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## INTEX-NA 1-MINUTE TRAJECTORIES - FSU METEOROLOGY

07 DAYS BACK FROM FLIGHT ON 12 JUL 2004  
INITIATED AT FLIGHT LEVEL FOR FLIGHT LEG 5



To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

FLIGHT LEG

Leg 6

ARRIVAL LEVEL

Flight Track

DURATION

7 days

**MAKE PLOT**

Scroll through legs with

PREV

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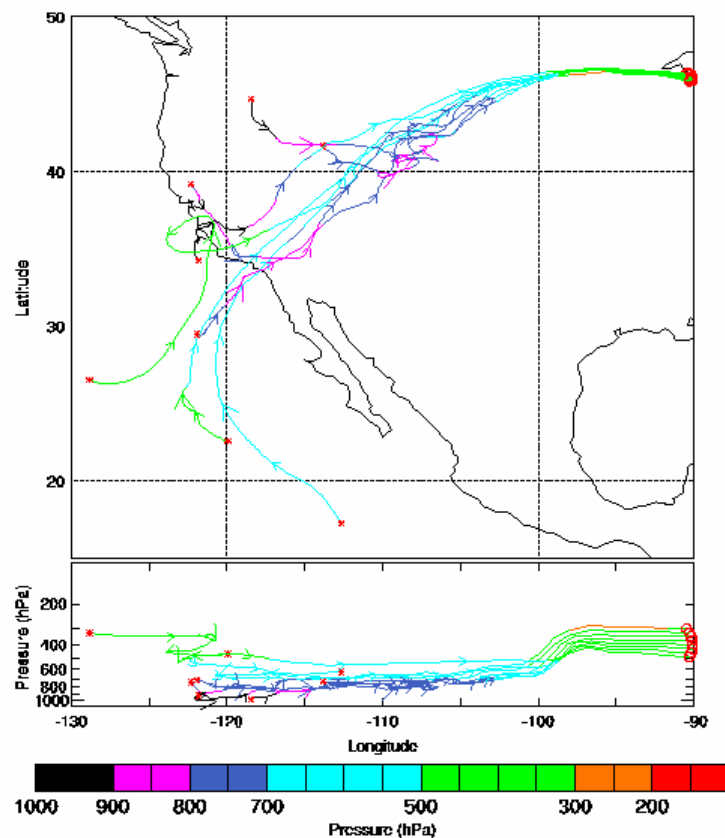
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and lightning products](#)

Jump to another flight

Flight 07 - 12 JUL

[MAIN FSU INTEX-NA PAGE](#)**INTEX-NA 1-MINUTE TRAJECTORIES - FSU METEOROLOGY**

07 DAYS BACK FROM FLIGHT ON 12 JUL 2004  
INITIATED AT FLIGHT LEVEL FOR FLIGHT LEG 6



To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

## FLIGHT LEG

Leg 6

Leg 6

Leg 7

Leg 8

Leg 9

Leg 10

Leg 11

Leg 12

Leg 13

Leg 14

Leg 15

Leg 16

Leg 17

Leg 18

Leg 19

Leg 20

Leg 21

Leg 22

Leg 23

Leg 24

Leg 25

Leg 26

Leg 27

Leg 28

Leg 29

Leg 30

Leg 31

Leg 32

Leg 33

Leg 34

Leg 35

Scroll

s with

PRE

EXT

[Flight- image](#)[Pre-flight briefing](#)[Archiv e PBL](#)[and li ducts](#)

Jump

flight

Fligh

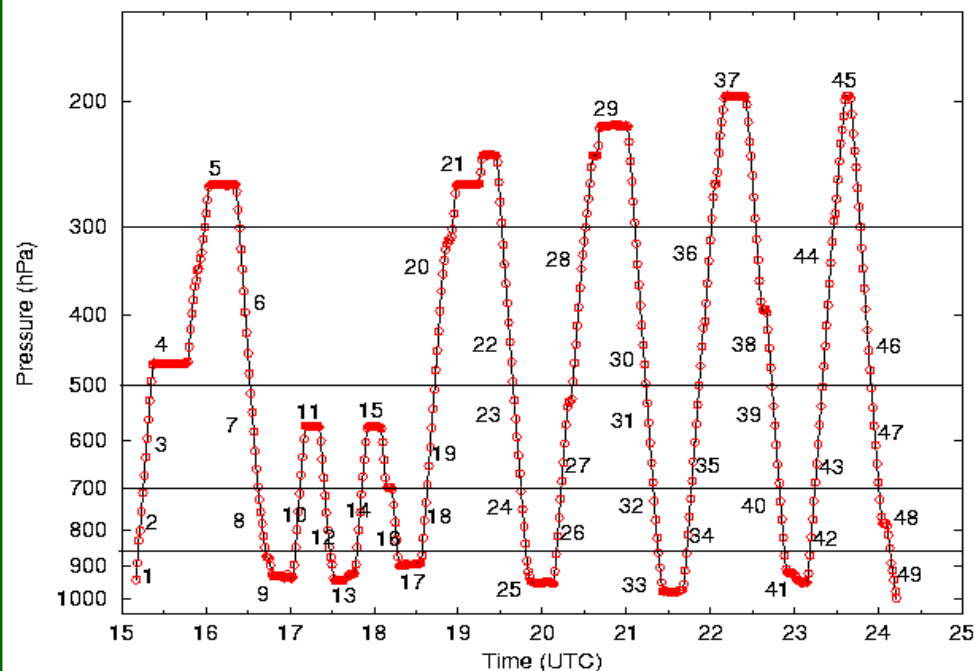
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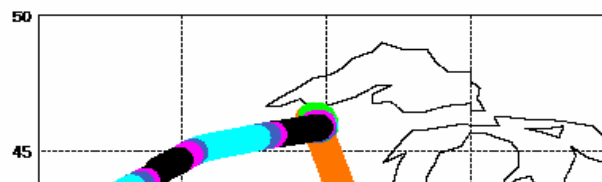
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## INTEX-NA FLIGHT 07

12 JUL 2004



## PATH FOR INTEX-NA FLIGHT ON 12 JUL 2004





To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

FLIGHT LEG

Leg 6

ARRIVAL LEVEL

Flight Track

Flight Track

300 hPa

500 hPa

700 hPa

850 hPa

MAKE PLOT

Scroll through legs with

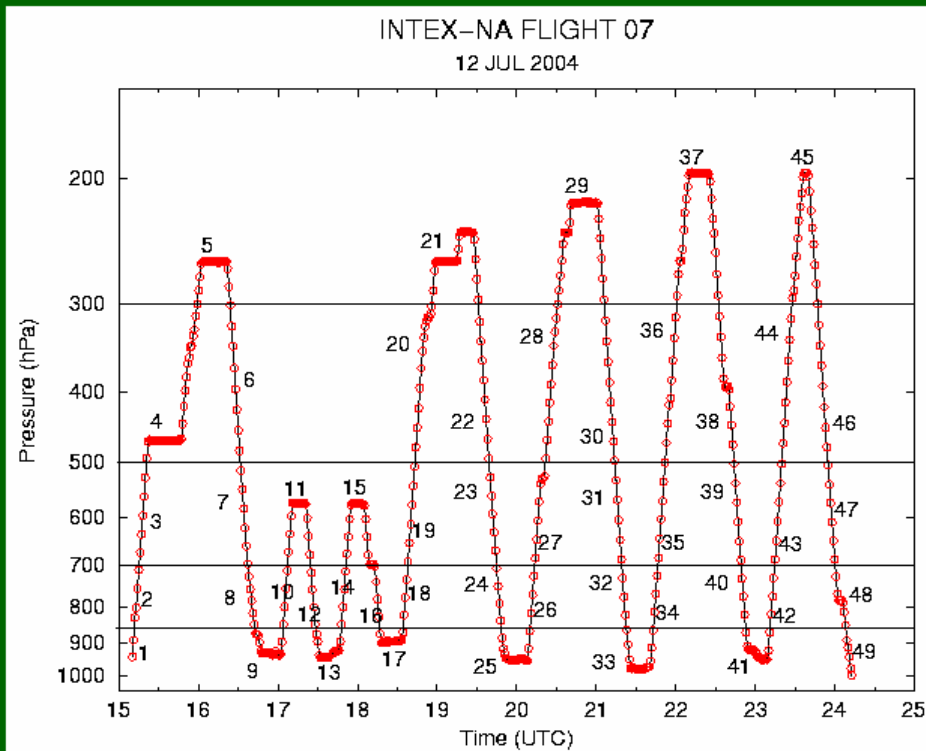
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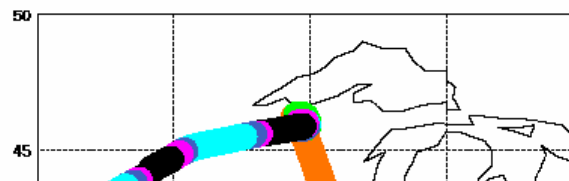
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Jump to another flight

Flight 07 - 12 JUL

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## PATH FOR INTEX-NA FLIGHT ON 12 JUL 2004



To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

FLIGHT LEG

Leg 15 ▾

ARRIVAL LEVEL

300 hPa ▾

DURATION

7 days ▾

**MAKE PLOT**

Scroll through legs with

PREV

&amp;

NEXT

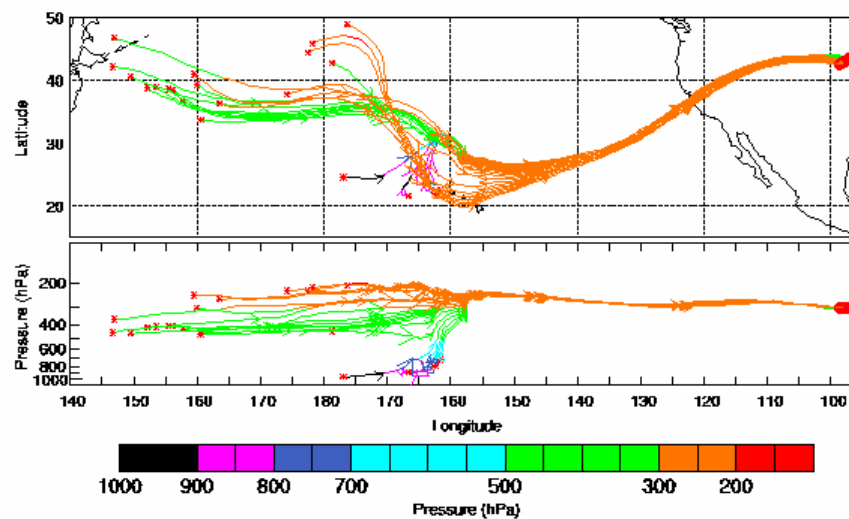
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and lightning products](#)

Jump to another flight

Flight 07 - 12 JUL ▾

[MAIN FSU INTEX-NA PAGE](#)**INTEX-NA 1-MINUTE TRAJECTORIES - FSU METEOROLOGY**

07 DAYS BACK FROM FLIGHT ON 12 JUL 2004  
INITIATED AT 300 hPa ORIGIN FOR FLIGHT LEG 15



To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

FLIGHT LEG

Leg 15 ▾

ARRIVAL LEVEL

300 hPa ▾

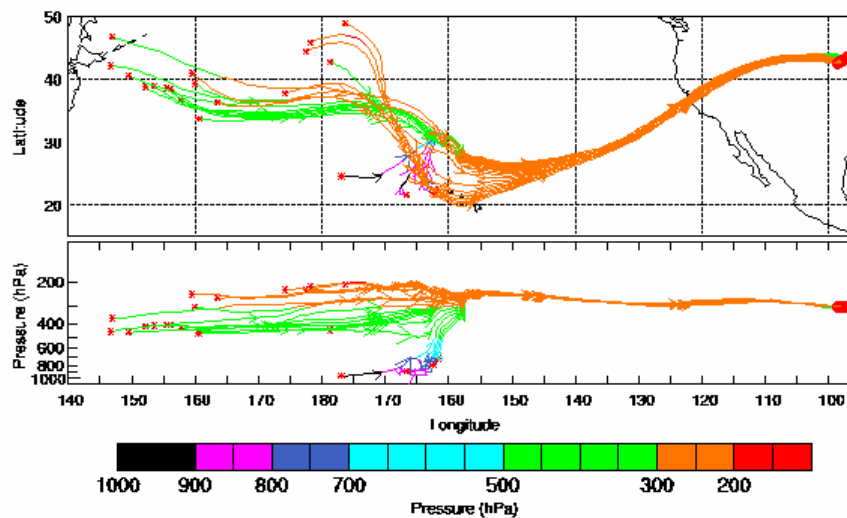
DURATION

Flight 03 - 01 JUL  
Flight 04 - 06 JUL  
Flight 05 - 08 JUL  
Flight 06 - 10 JUL  
Flight 07 - 12 JUL  
Flight 08 - 15 JUL  
Flight 09 - 18 JUL  
Flight 10 - 20 JUL  
Flight 11 - 22 JUL  
**Flight 12 - 25 JUL**  
Flight 13 - 28 JUL  
Flight 14 - 31 JUL  
Flight 15 - 02 AUG  
Flight 16 - 06 AUG  
Flight 17 - 07 AUG  
Flight 18 - 11 AUG  
Flight 19 - 13 AUG  
Flight 20 - 14 AUG

Flight 07 - 12 JUL ▾

[MAIN FSU INTEX-NA PAGE](#)**INTEX-NA 1-MINUTE TRAJECTORIES - FSU METEOROLOGY**

07 DAYS BACK FROM FLIGHT ON 12 JUL 2004  
INITIATED AT 300 hPa ORIGIN FOR FLIGHT LEG 15



To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

FLIGHT LEG

Leg 1

ARRIVAL LEVEL

Flight Track

DURATION

10 days

MAKE PLOT

Scroll through legs with

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[Flight-time GOES image](#)[Pre-flight MET briefing](#)[Archive of realtime PBL  
and lightning products](#)

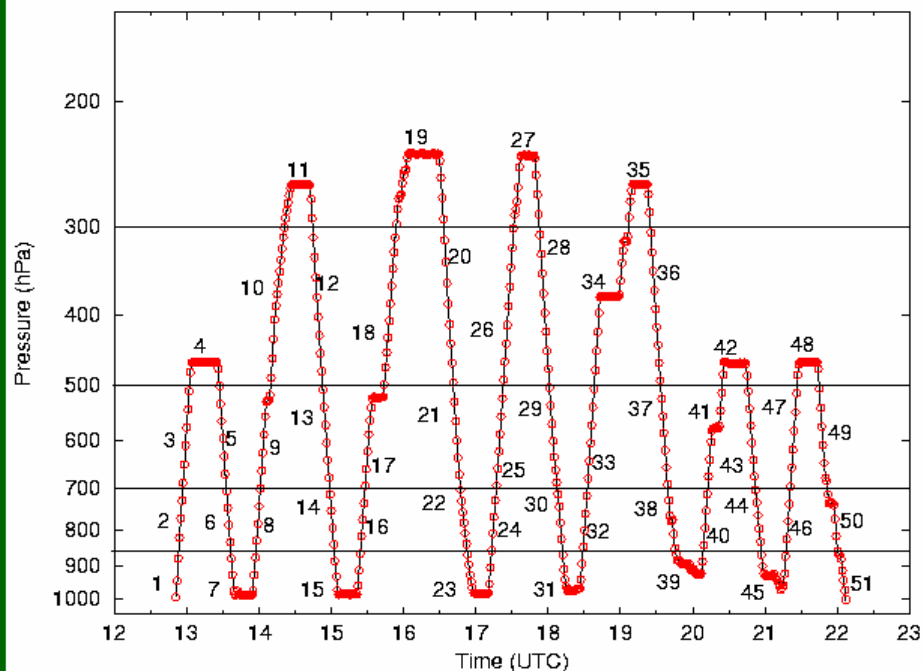
Jump to another flight

Flight 12 - 25 JUL

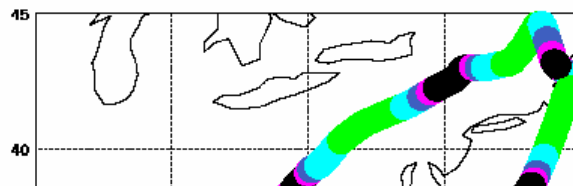
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## INTEX-NA FLIGHT 12

25 JUL 2004



## PATH FOR INTEX-NA FLIGHT ON 25 JUL 2004





## NASA INTEX-NA 2004

### Florida State University

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#### Available Products: Post Mission Reanalysis

**10-day Backward Trajectories**--Trajectories start at 1-minute intervals throughout the duration of each DC-8 flight. Available products include trajectories calculated from exact flight positions, as well as trajectories arriving at constant pressure levels (300, 500, 700 and 850 hPa) along the flight path.

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Global 1.0 by 1.0 degree CO emissions fields were created at Harvard University and consist of Street's Asian emissions [*Streets et al., J. Geophys. Res.*, 108 (D21) 8809, doi:10.1029/2002JD003093, 2003; *Woo et al., J. Geophys. Res.*, 108 (D21) 8812, doi:10.1029/2002JD003200, 2003.] superimposed on Logan's global emissions [*Duncan et al., J. Geophys. Res.*, 108 (D2), 4100, doi:10.1029/2002JD002378, 2003].

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FSU INTEX-NA meteorological and backward trajectory products

Choose Desired DC-8 Flight:

Jul 06, 2004	DC-8 Flight 04
Jul 08, 2004	DC-8 Flight 05
Jul 10, 2004	DC-8 Flight 06
Jul 12, 2004	DC-8 Flight 07
Jul 15, 2004	DC-8 Flight 08
Jul 18, 2004	DC-8 Flight 09
Jul 25, 2004	DC-8 Flight 12
Jul 28, 2004	DC-8 Flight 13
Aug 14, 2004	DC-8 Flight 20

Go

FSU INTEX-NA for Lagrangian cases

at:

Jul 06, 2004	DC-8 Flight 04
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Go

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Done Internet

To view trajectories, select a [Flight Leg](#), Arrival Level, and Duration, then click on **MAKE PLOT**

FLIGHT LEG

Leg 1

ARRIVAL LEVEL

Flight Track

DURATION

10 days

MAKE PLOT

Scroll through legs with

PREV & NEXT

[Flight-time GOES image](#)

[Backward Trajectories](#)

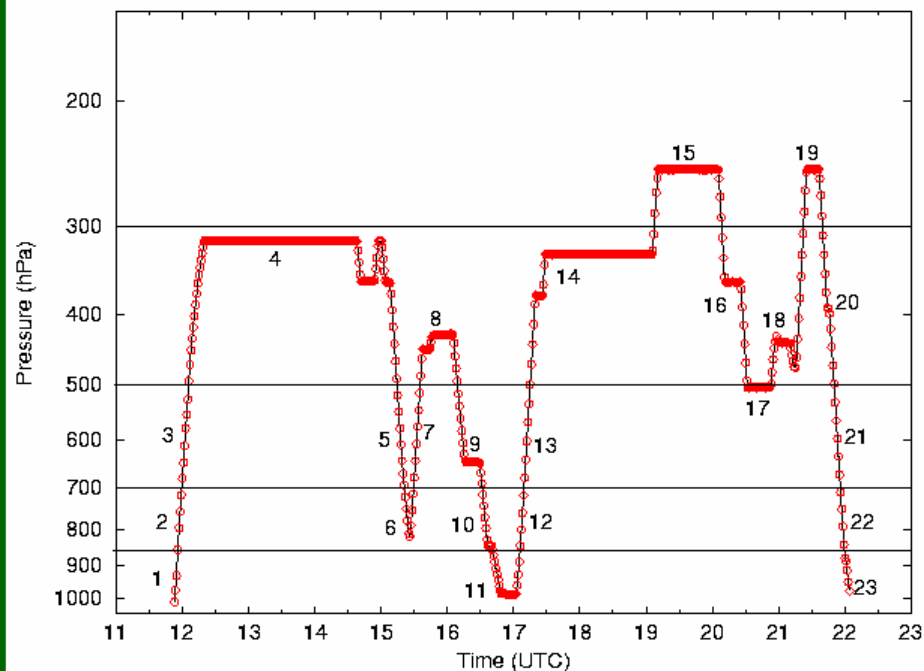
Jump to another flight

Flight 13 - 28 JUL

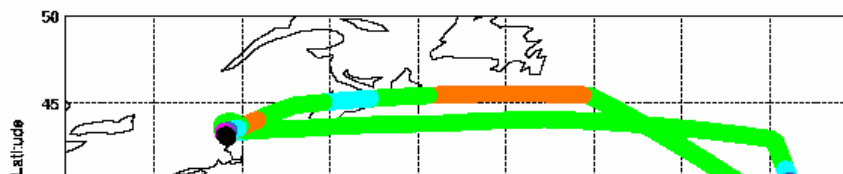
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## INTEX-NA FLIGHT 13

28 JUL 2004



## PATH FOR INTEX-NA FLIGHT ON 28 JUL 2004



To view trajectories, select a [Flight Leg](#), Arrival Level, and Duration, then click on **MAKE PLOT**

FLIGHT LEG

Leg 1

Leg 2

Leg 3

Leg 4

Leg 5

Leg 6

Leg 7

Leg 8

Leg 9

Leg 10

Leg 11

Leg 12

Leg 13

Leg 14

Leg 15

Leg 16

Leg 17

Leg 18

Leg 19

Leg 20

Leg 21

Leg 22

Leg 23

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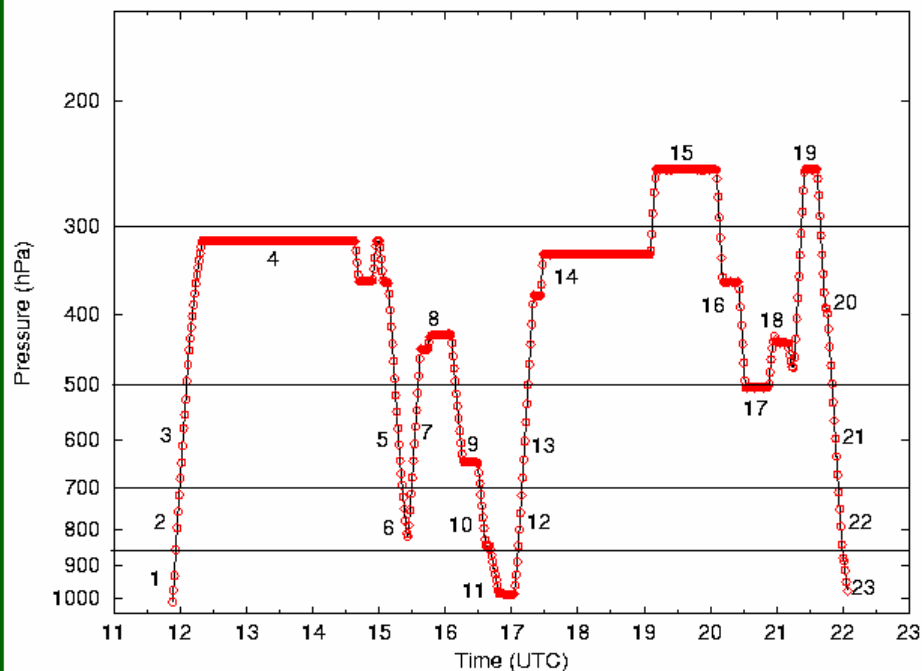
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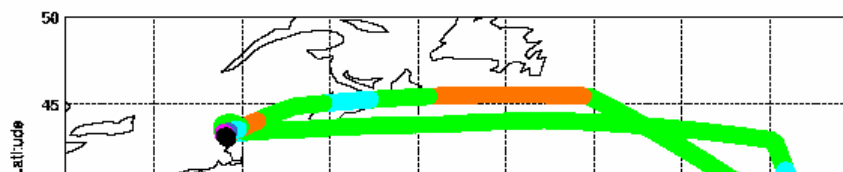
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# INTEX-NA FLIGHT 13

28 JUL 2004



## PATH FOR INTEX-NA FLIGHT ON 28 JUL 2004





To view trajectories, select a  
[Flight Leg](#), Arrival Level, and  
Duration, then click on  
**MAKE PLOT**

FLIGHT LEG

Leg 11

ARRIVAL LEVEL

Flight Track

DURATION

10 days

**MAKE PLOT**

Scroll through legs with

**PREV** & **NEXT**

[Flight-time GOES image](#)

[Backward Trajectories](#)

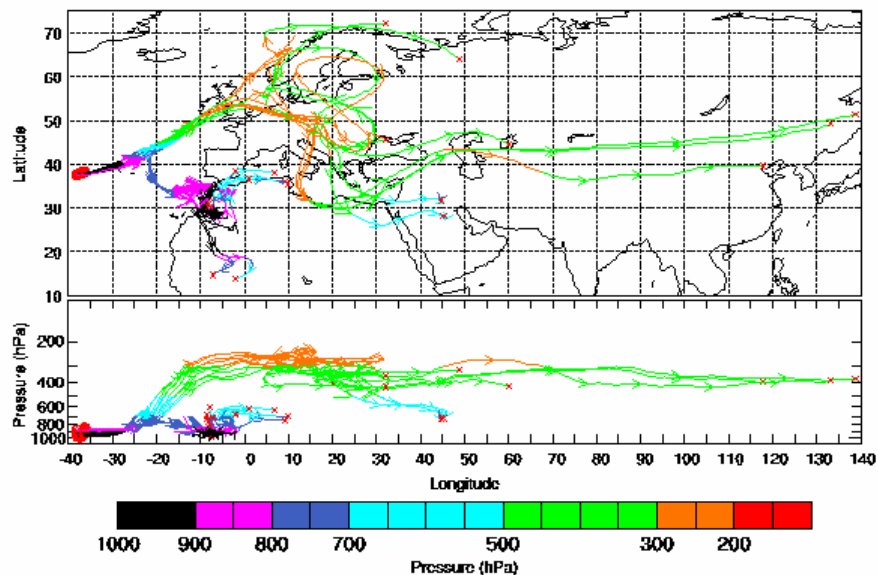
Jump to another flight

Flight 13 - 28 JUL

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# INTEX-NA 1-MINUTE TRAJECTORIES - FSU METEOROLOGY

10 DAYS FORWARD FROM FLIGHT ON 28 JUL 2004  
INITIATED AT FLIGHT LEVEL FOR FLIGHT LEG 11



<http://bertha.met.fsu.edu/INTEX/>

atmosphere

airborne

[mporter@met.fsu.edu](mailto:mporter@met.fsu.edu)

# Lightning NOx

## INTEX-A

Michael Porter

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# Goals

- Explore the connection of observed NO<sub>x</sub> to convective influence as indicated by flash data, expanding upon the 'lightning tracing' concept from SONEX by Jeker et al., 2000
- Use INTEx data to estimate post-convective vertical profiles of Lightning generated NO<sub>x</sub>, along the lines of Pickering et al., 1998

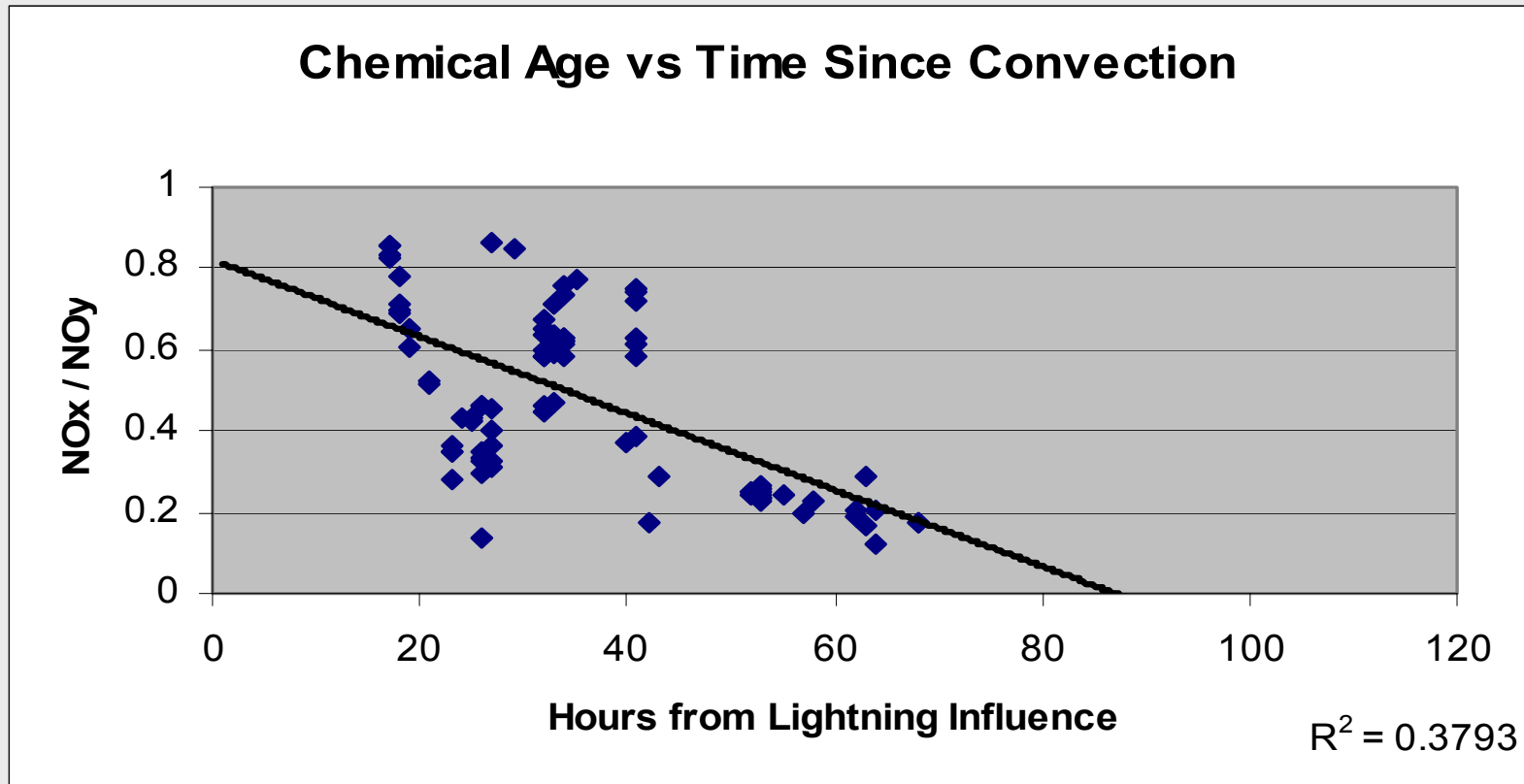
# Points to Consider

- Distinguishing BL venting from Lightning influence
- Thresholds for assessing Lightning influence (spatial, temporal, intensity)
- Cumulative influence vs most recent convection
- Comparison between this and other methods of assessing convective influence
- Compare observed NO<sub>x</sub> to estimated NO production from flash data

# Exploring age of LNOx

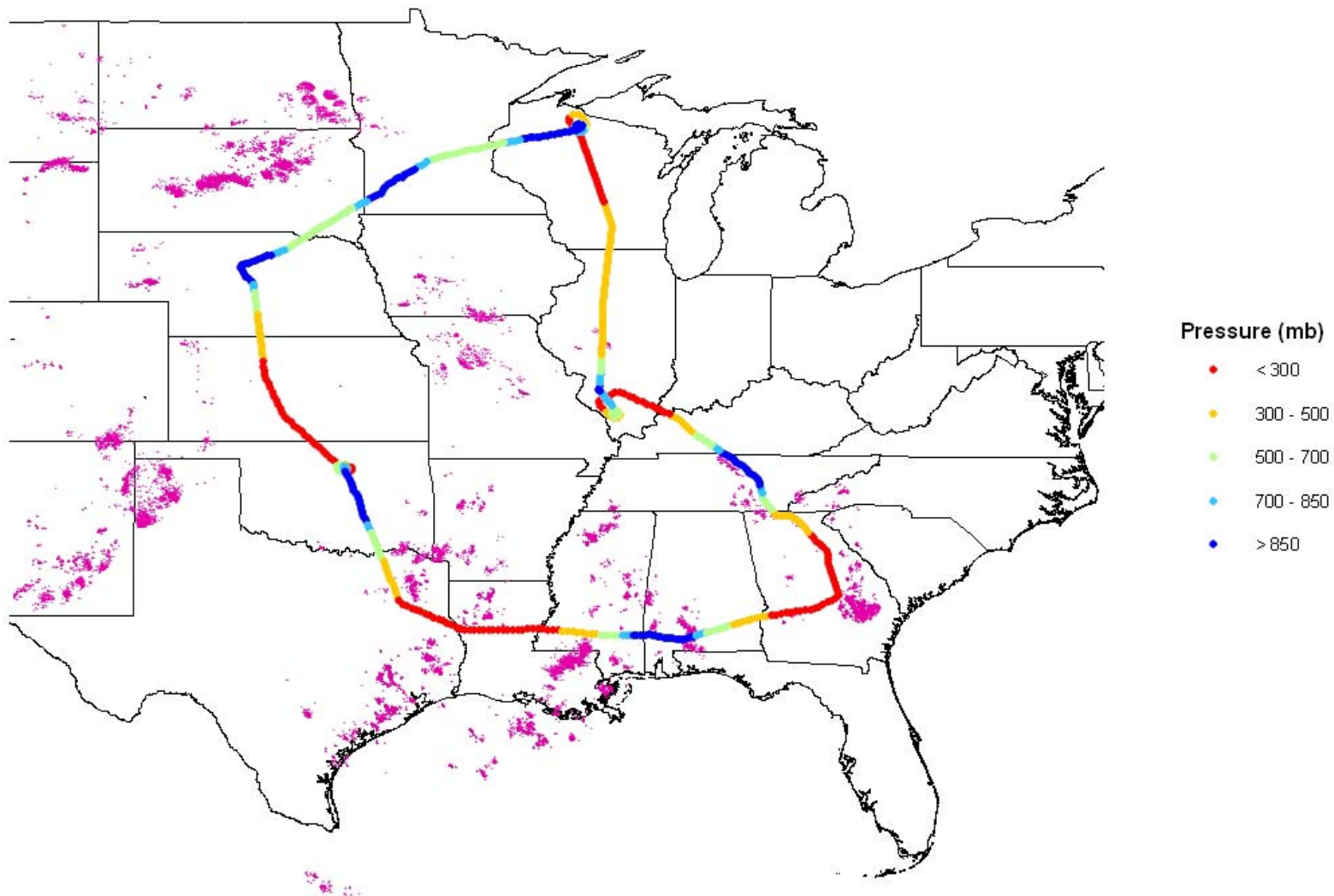
- Flight 12 (0725)
- Counts NLDN flashes within X km of trajectory  
( $X = 2 \text{ km} * \text{hours back from flight}$ )
- Occurring up to 2 hrs before or 0.5 after trajectory
- Ignores trajectories that enter BL
- Stops trajectory 2 hrs after its first encounter with 20 or more flashes

# NO<sub>x</sub>:NO<sub>y</sub> vs Time Since Lightning



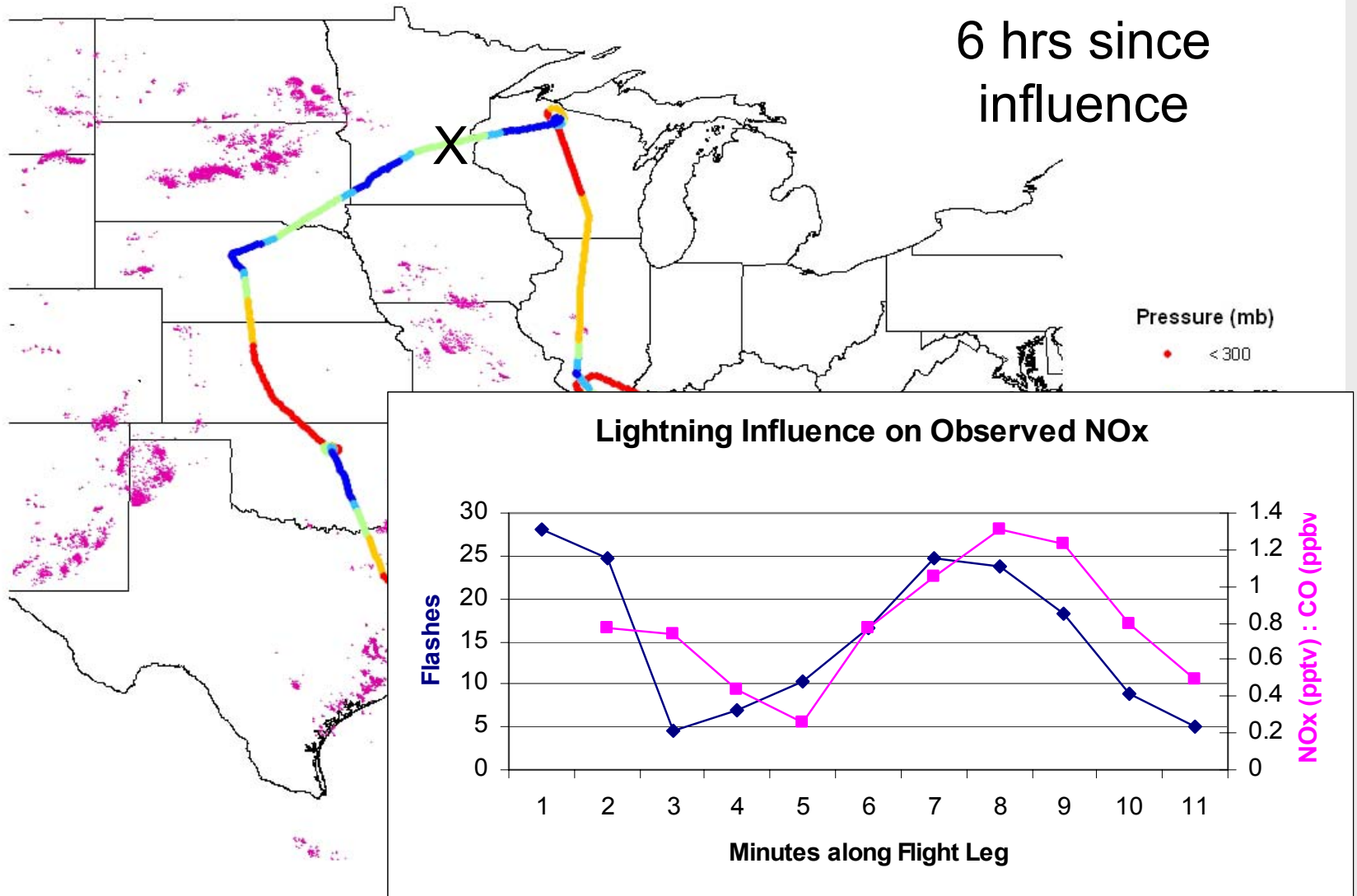
- 3 min running averages (over level flight) used for chemistry and lightning influence

# Flight on 0712

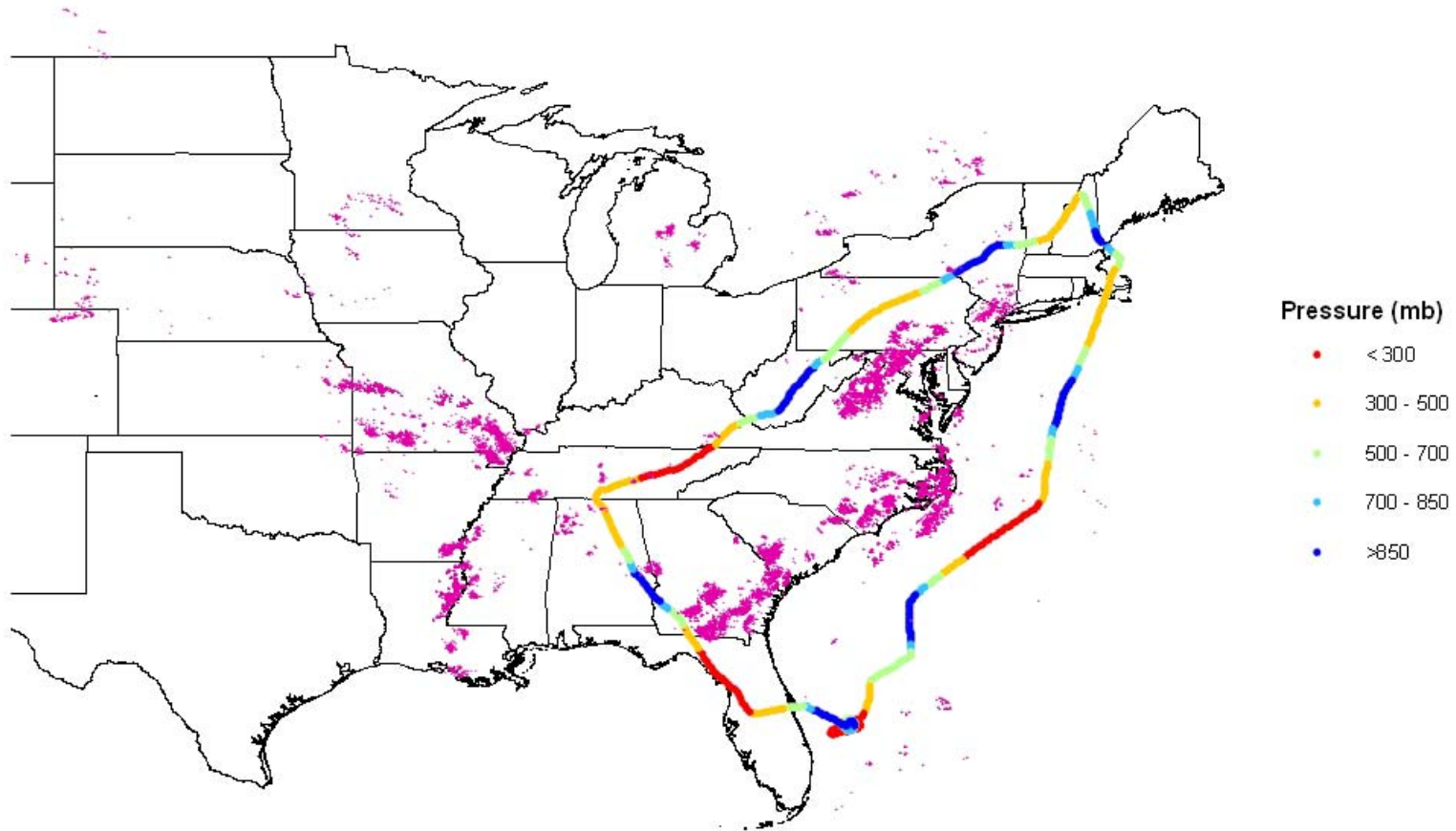




# Dakota Convection



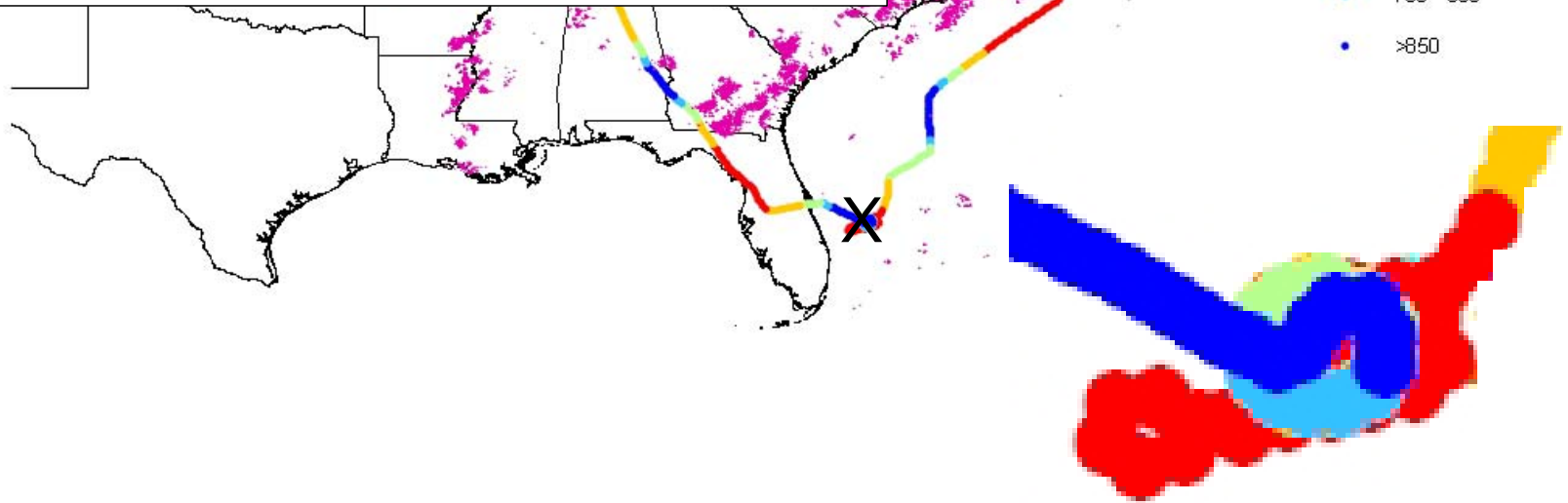
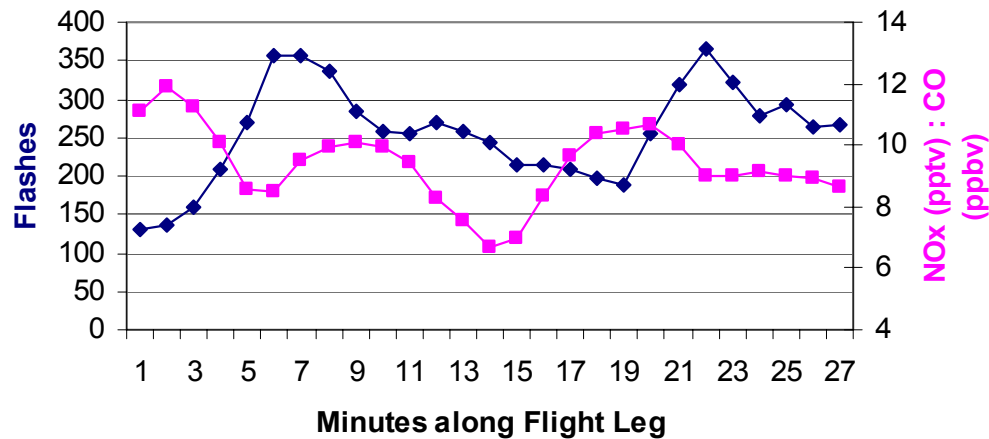
# Flight on 0725



# NC Convection

33 hrs since  
influence

Lightning Influence on Observed NOx



# Conclusion

- Explore the connection of observed NO<sub>x</sub> to convective influence as indicated by flash data,
- Use INTEX data to estimate post-convective vertical profiles of Lightning generated NO<sub>x</sub>

# A Comprehensive Investigation of Warm Season Lofting and Transport Episodes

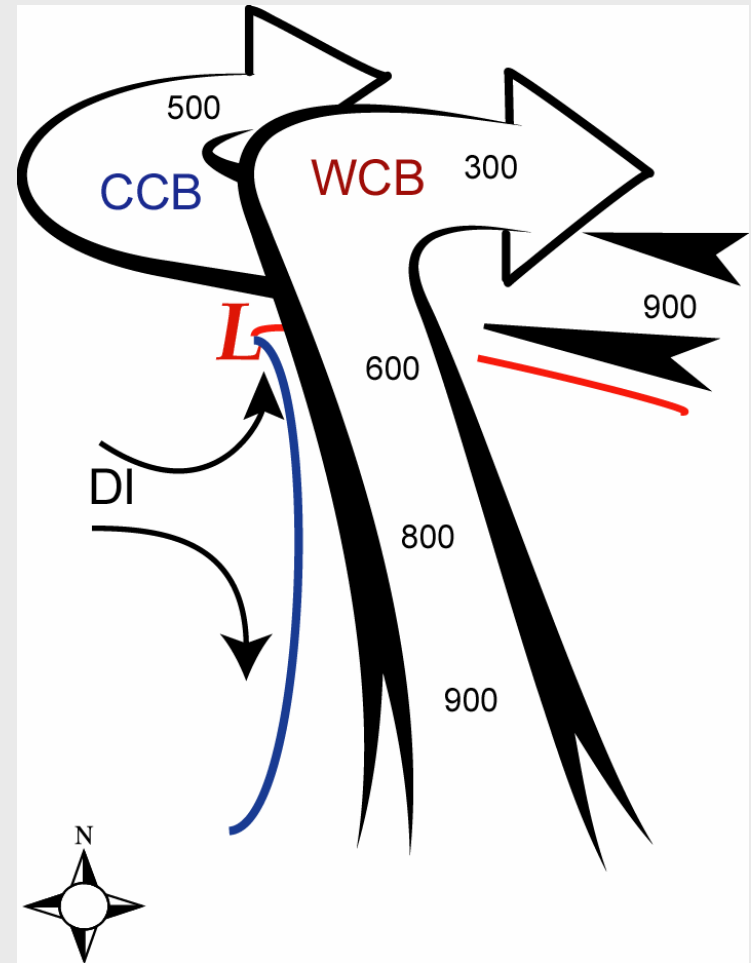
Chris Kiley

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# Warm Conveyor Belts

**warm conveyor belt**—A narrow stream of air that transports large amounts of heat, moisture, and westerly momentum. (Glossary of Meteorology)

**warm conveyor belt**—Air which originated far south of the low in the warm sector, ascended toward the north, achieved saturation near or north of the warm front, where it rose more rapidly, and joined the upper-level westerly flow northeast of the low center. (Carlson, T.N., 1980)



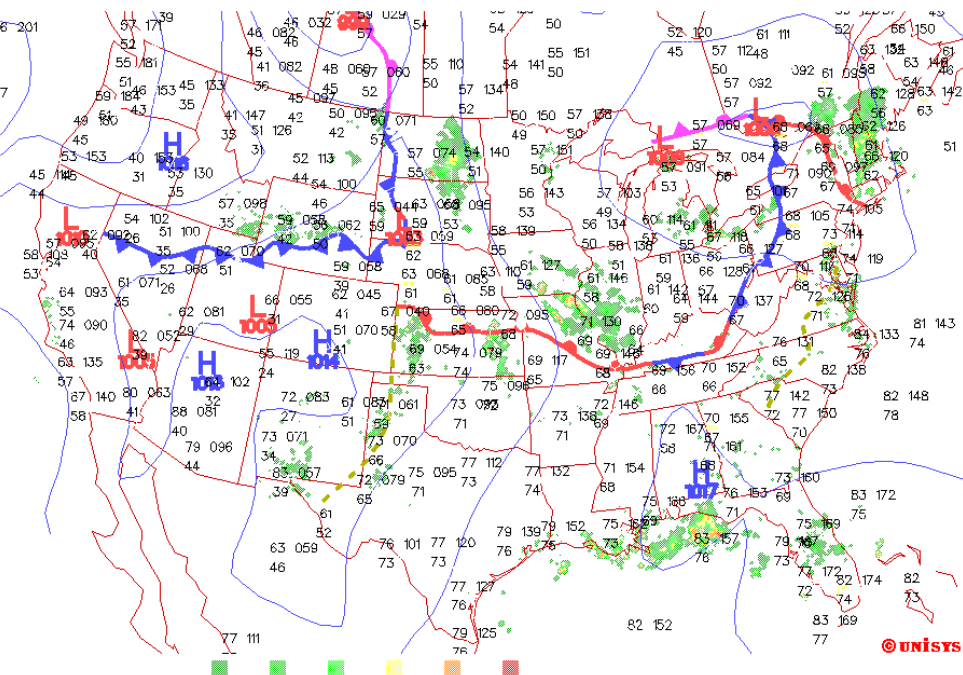
# Warm Conveyor Belts

- WCBs and deep convection have been shown to be the primary mechanisms for transporting pollution during the cool season
- Transport during the other half of the year, the warm season, has received much less attention
- WCBs are assumed to be weaker during the warm season; however, they still are probably major transport mechanisms
- Lifting and transport mechanisms documented during INTEx-A will be compared with the classical definition of WCBs
- Examine CO transport and its depiction by AIRS

# Three Interesting Cases

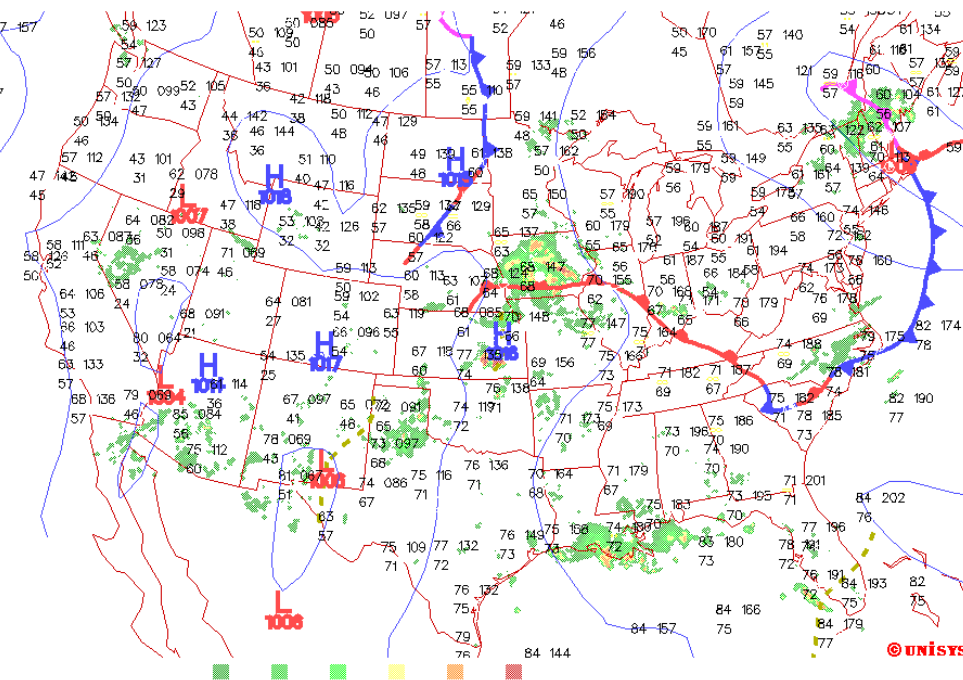
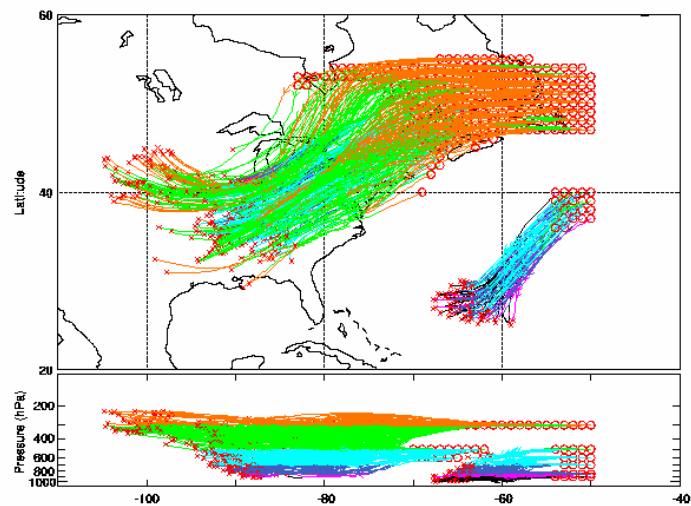
- July 8-9
- July 18-22
- August 5-8





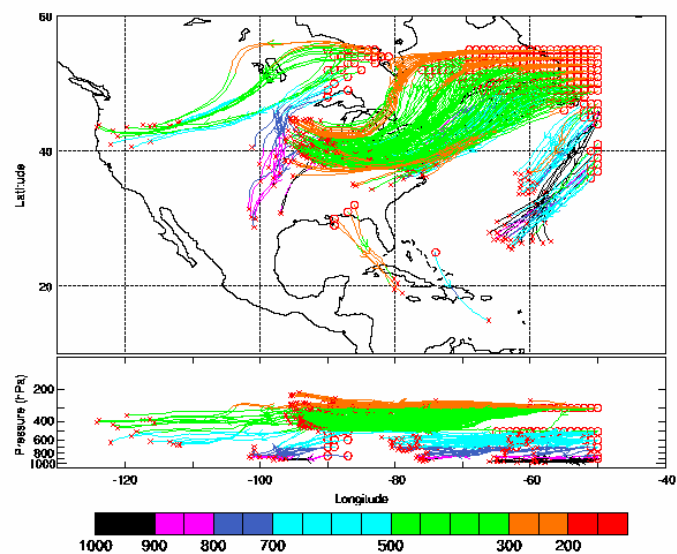
# July 8

2004 JUL 08 18Z



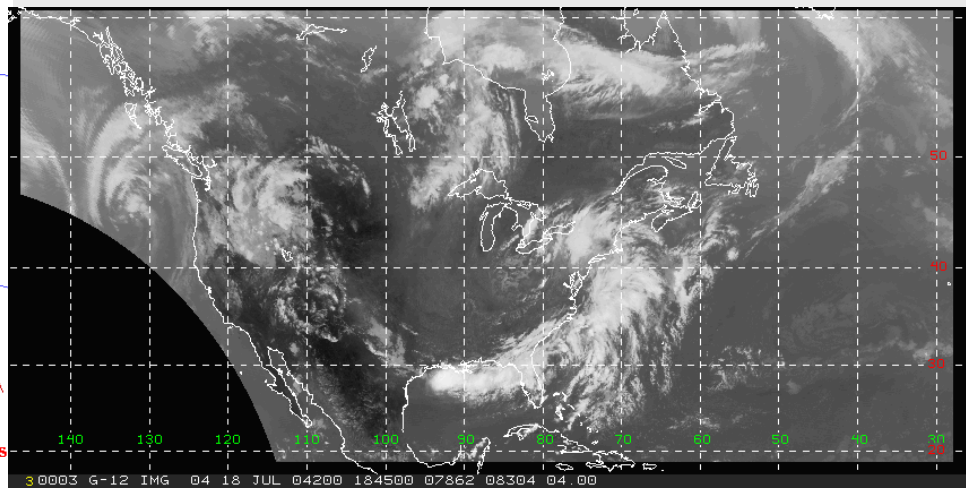
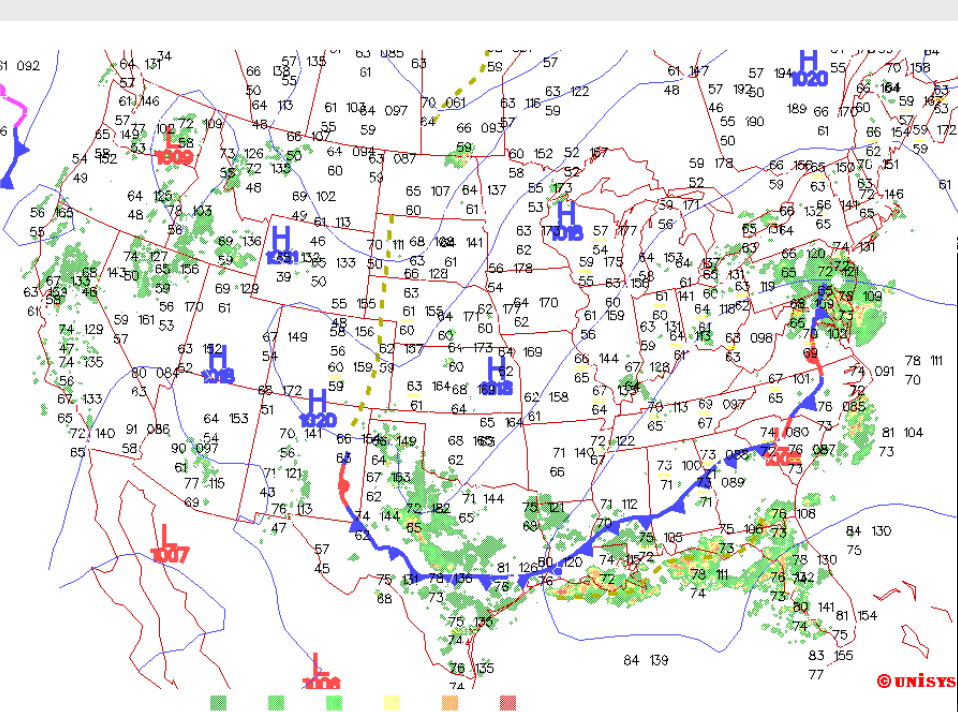
# July 9

2004 JUL 09 18Z

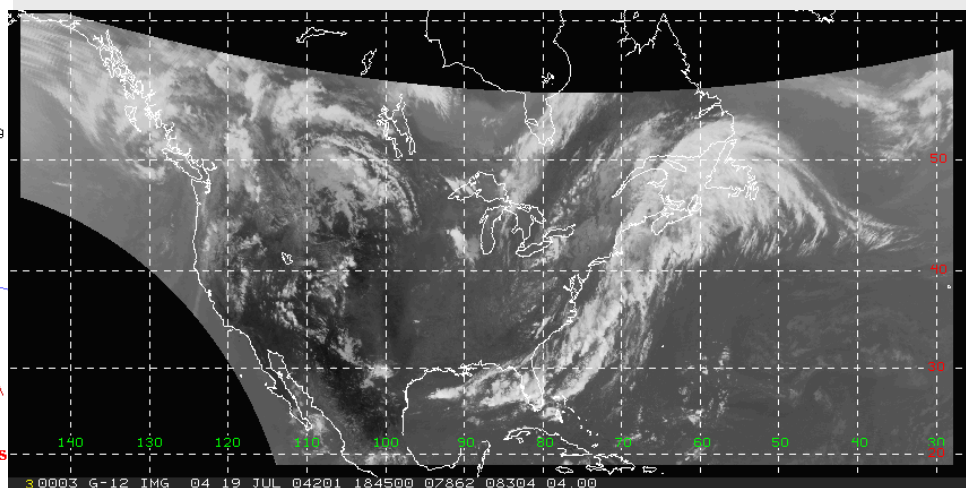
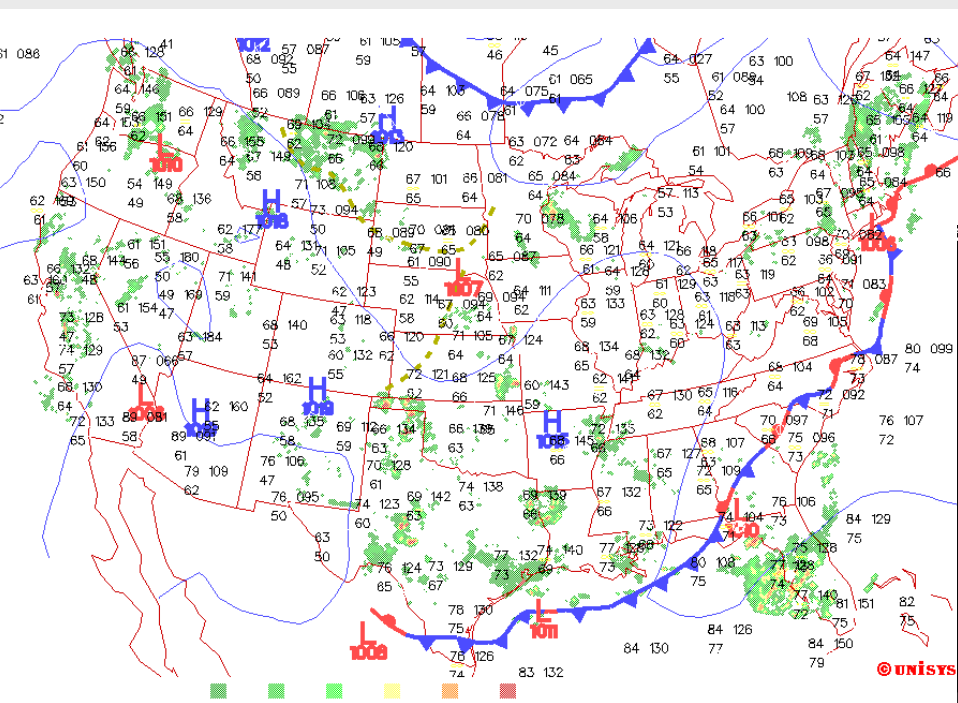


# 4 Day Case

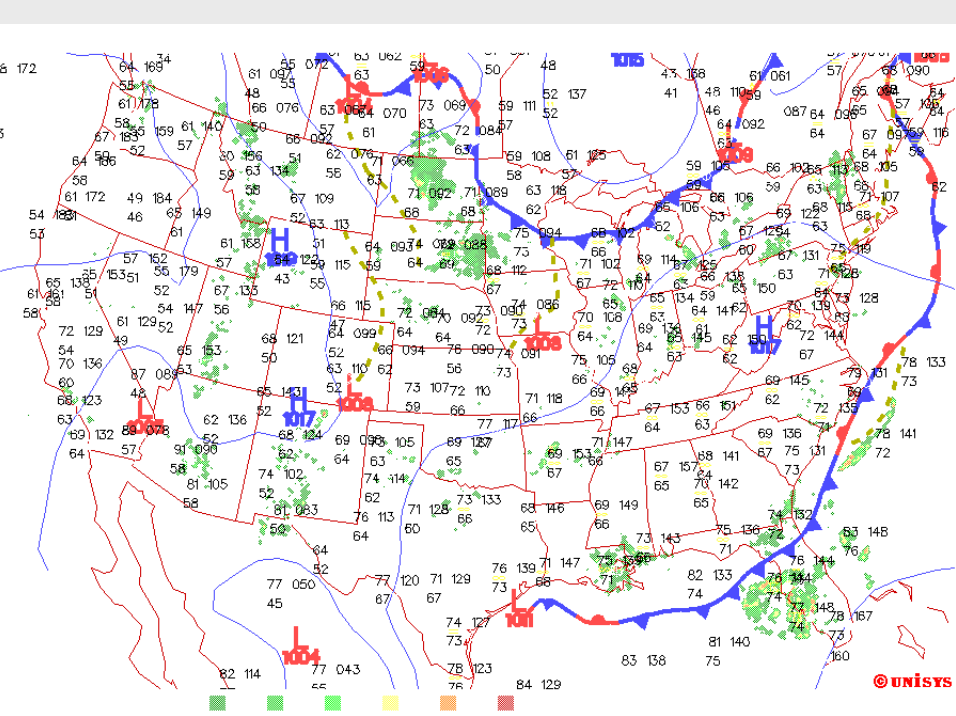
## July 18



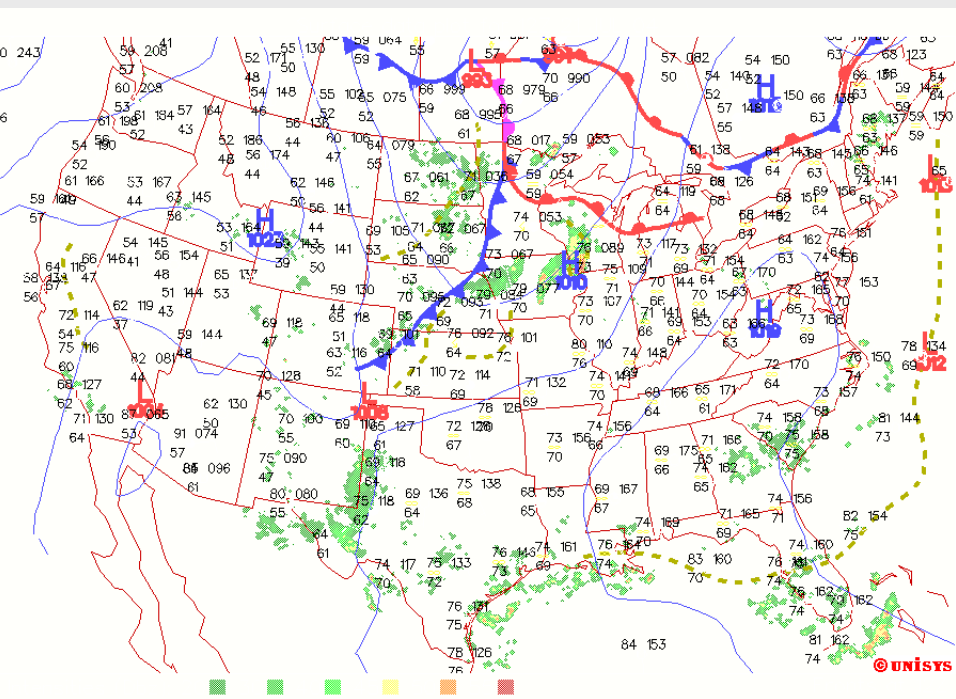
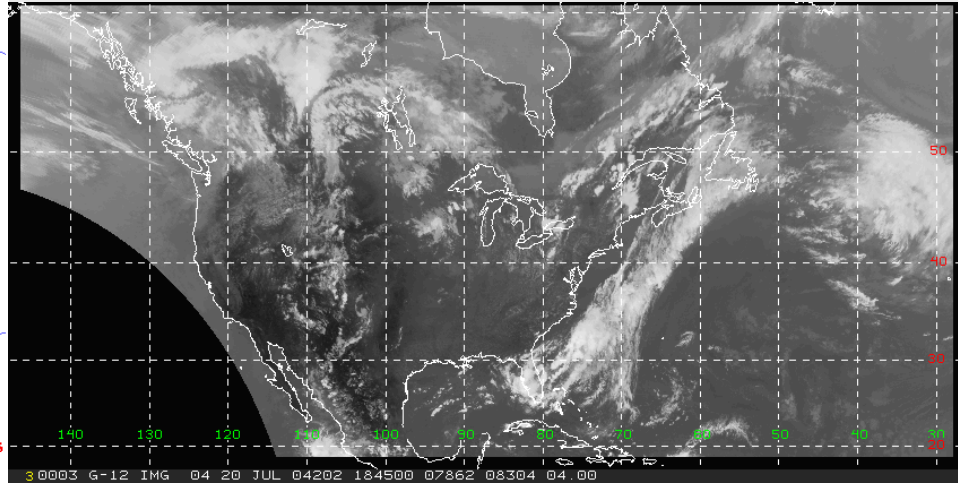
## July 19



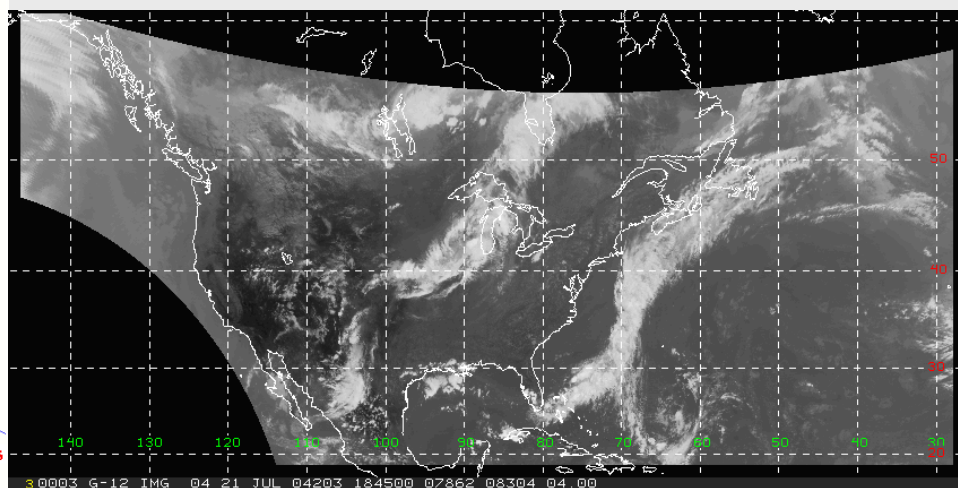




July 20

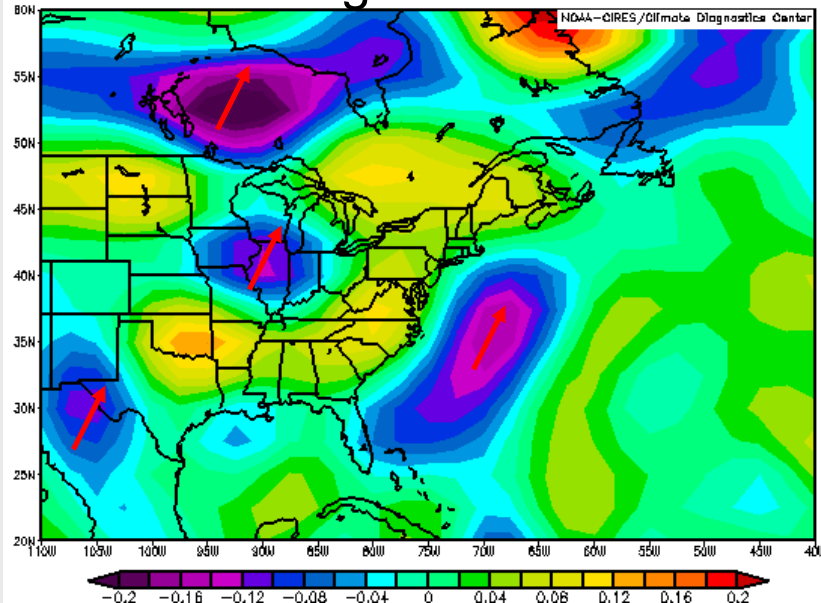


July 21

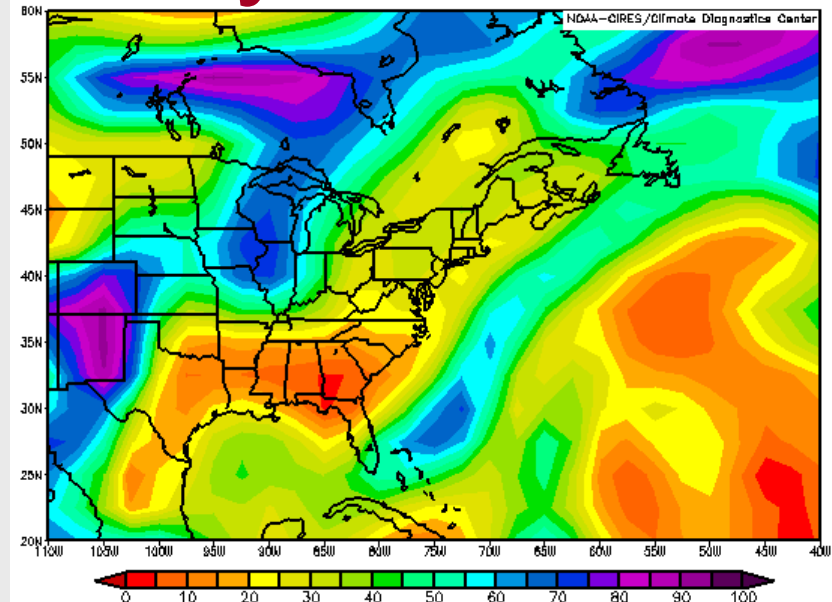


# Focus on July 21

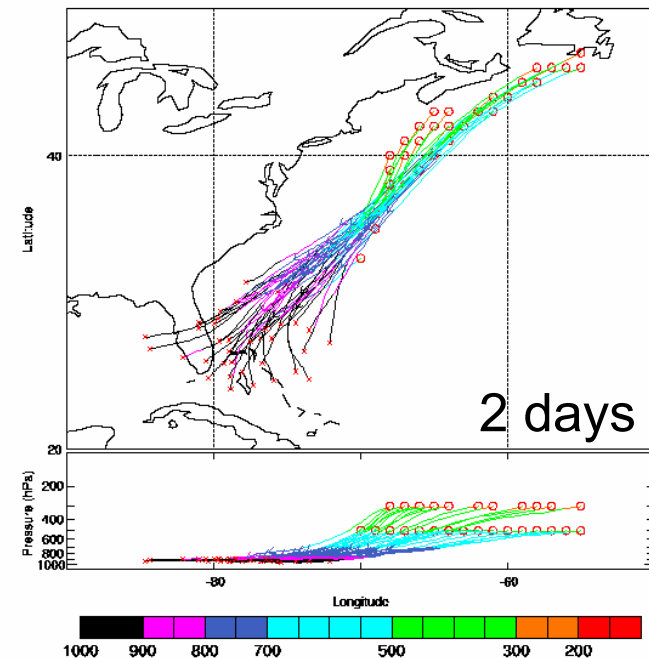
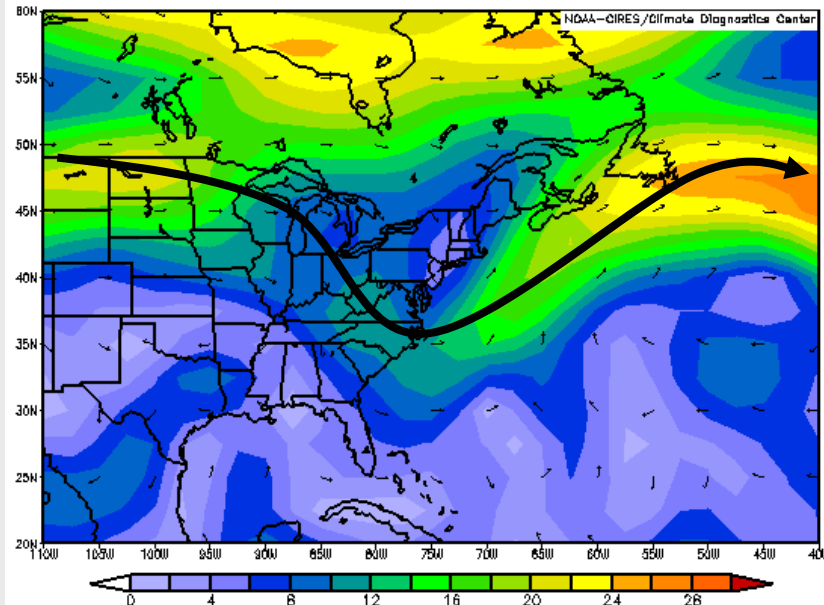
700 hPa Omega



500 hPa RH



500 hPa Winds



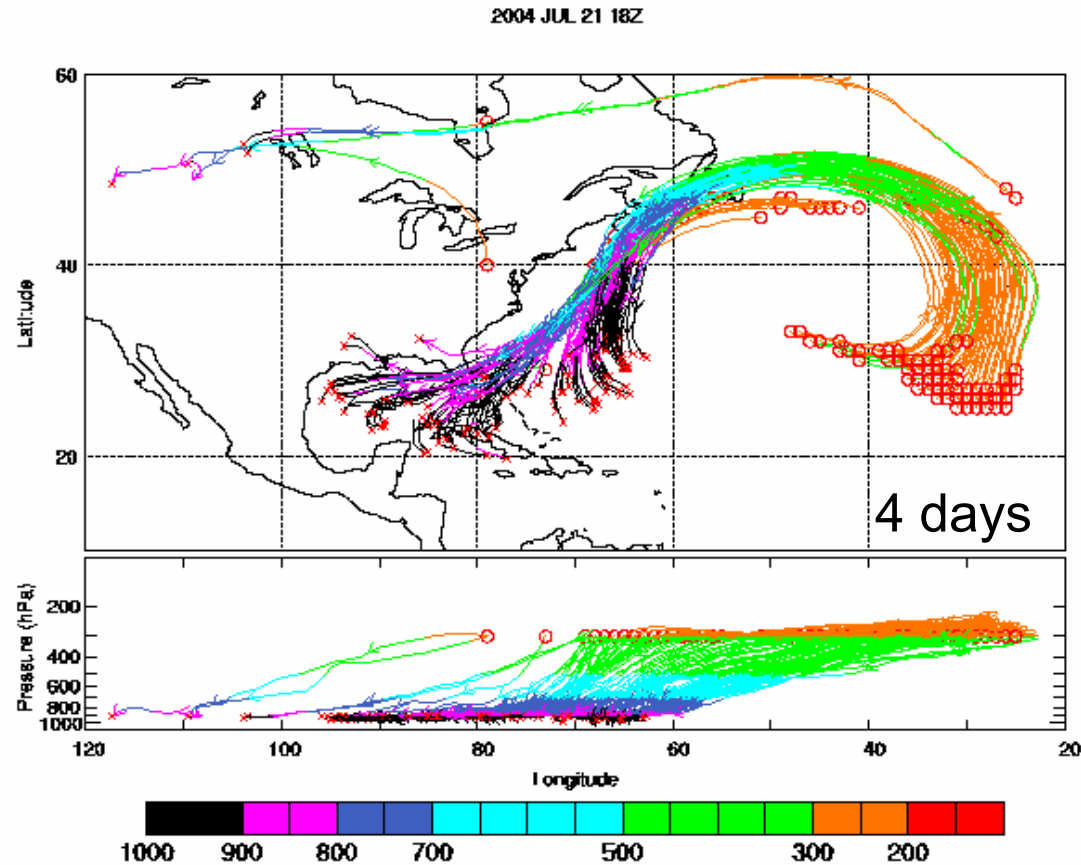
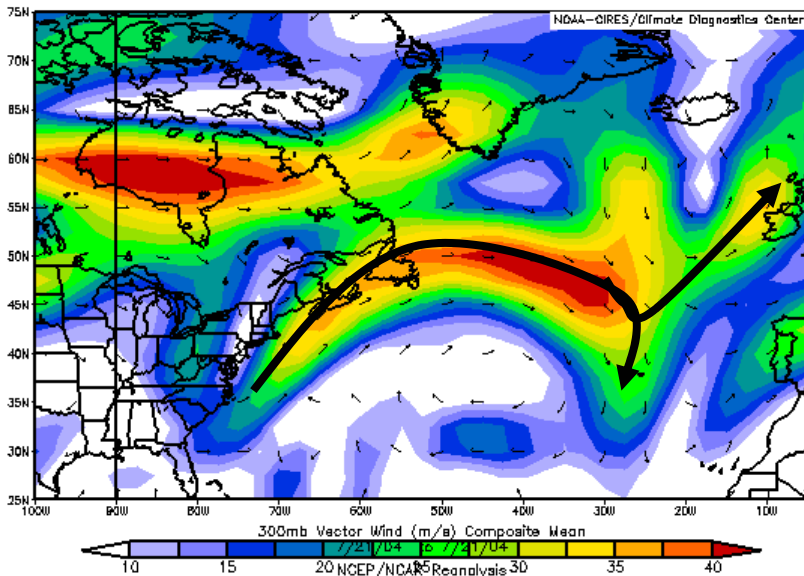
# Focus on July 21

- Meets preliminary WCB criteria
- Will this WCB transport boundary layer air to Europe?

# Focus on July 21

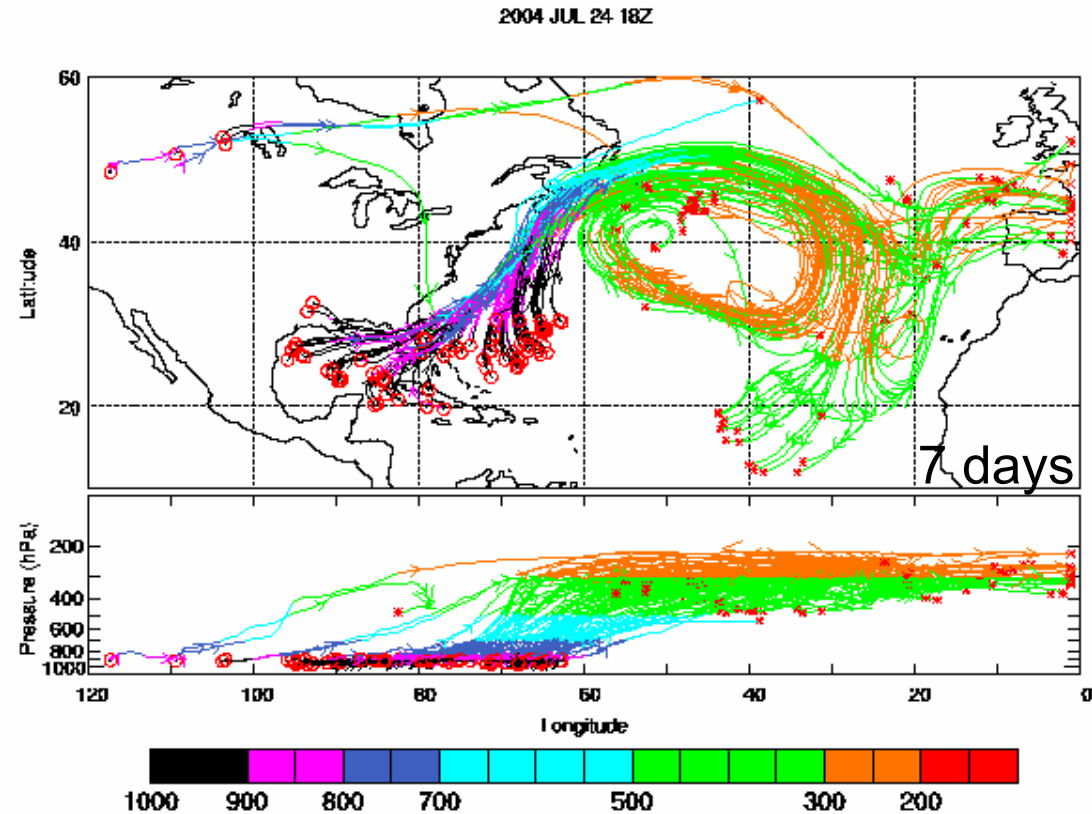
- Not exactly!

## 300 hPa Winds



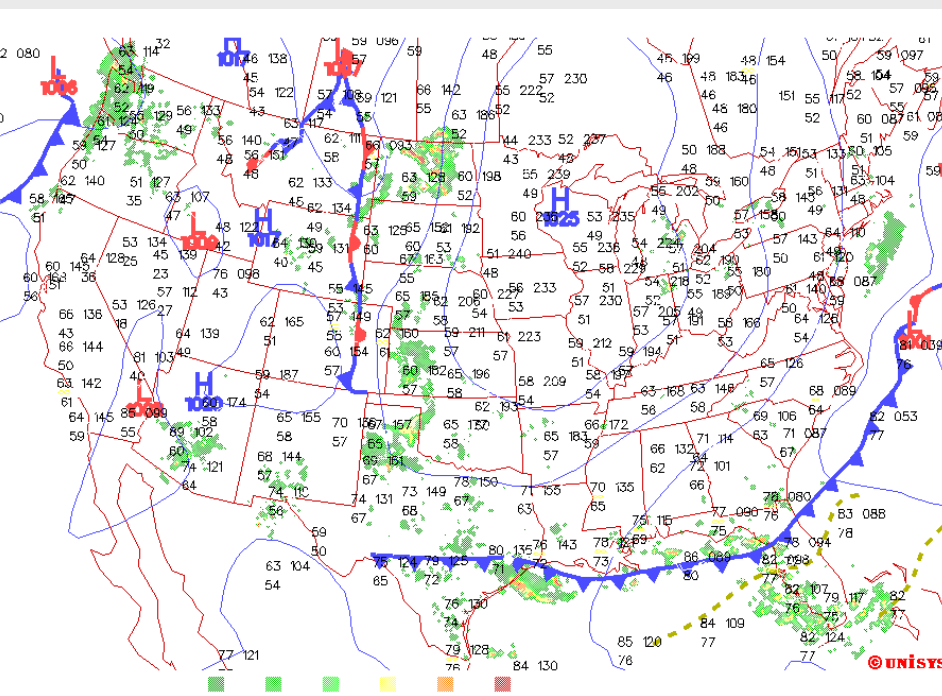
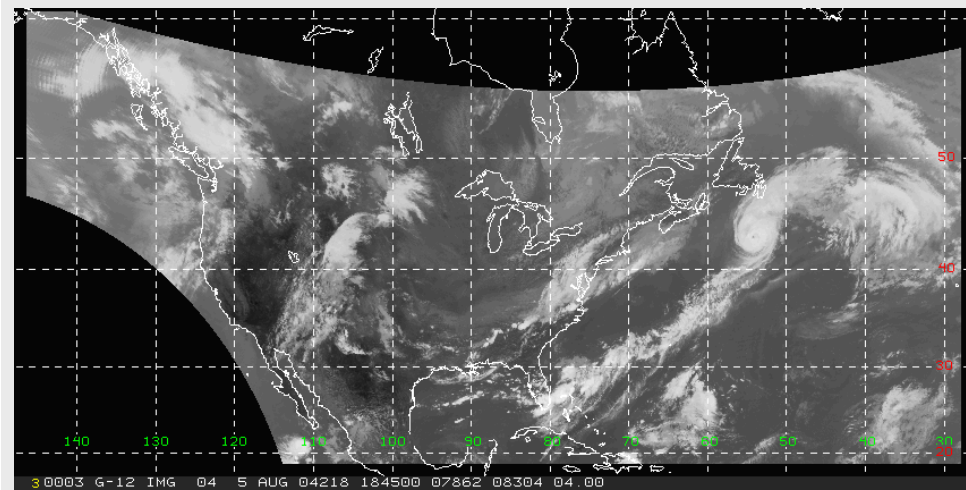
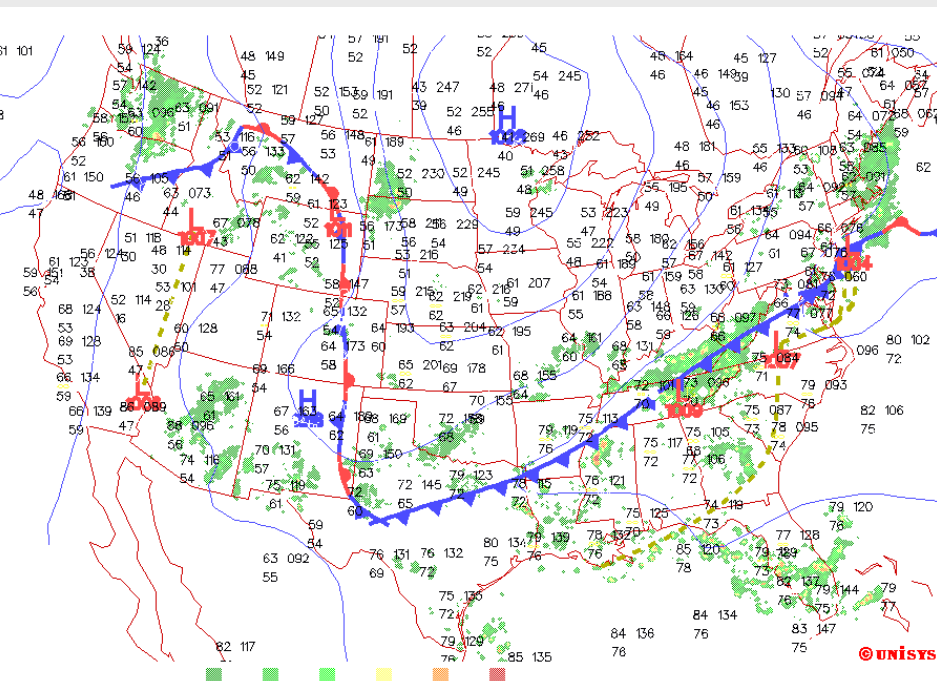
# Focus on July 21

But, eventually!  
3 days later

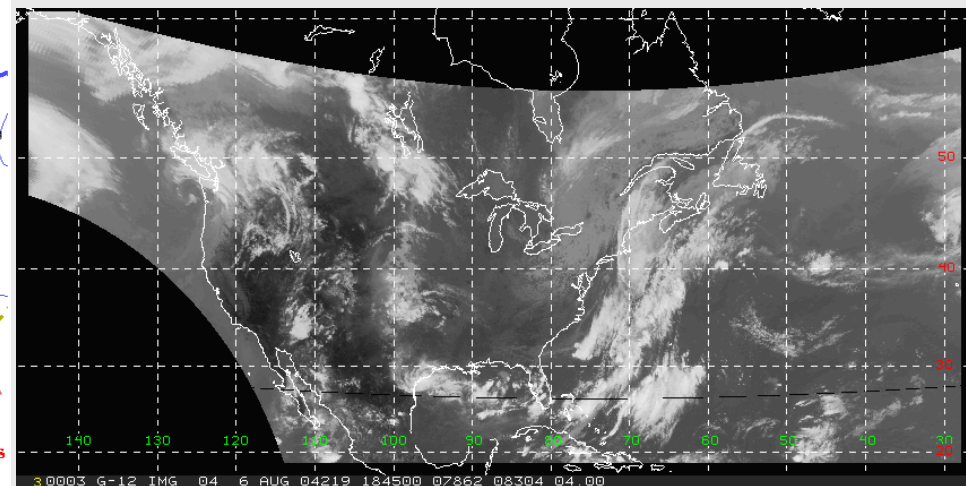




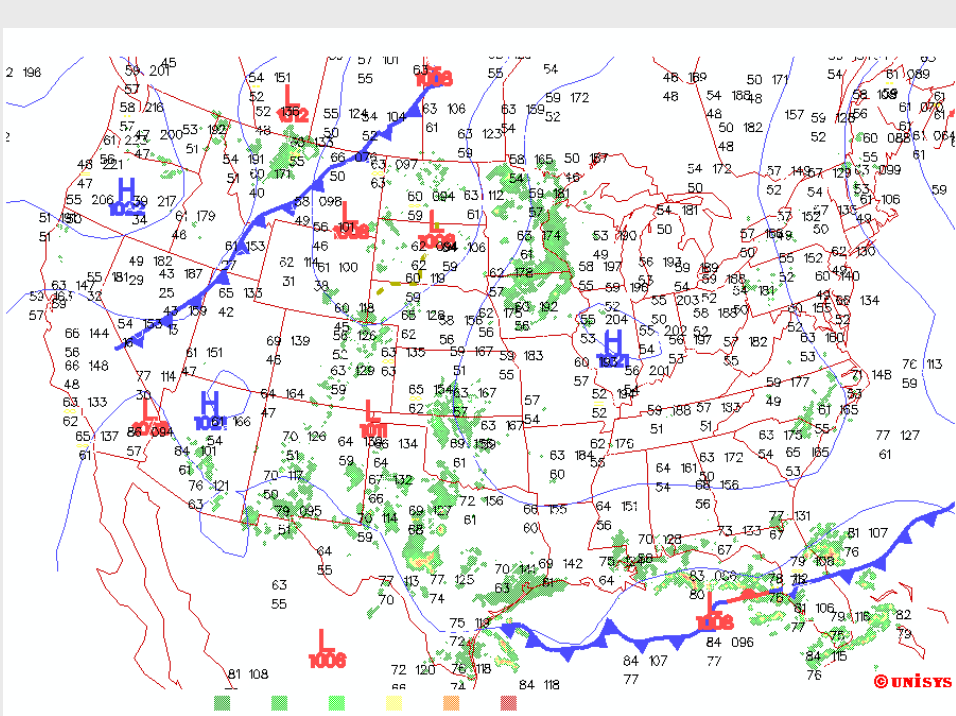
# 4 Day Case Aug 5



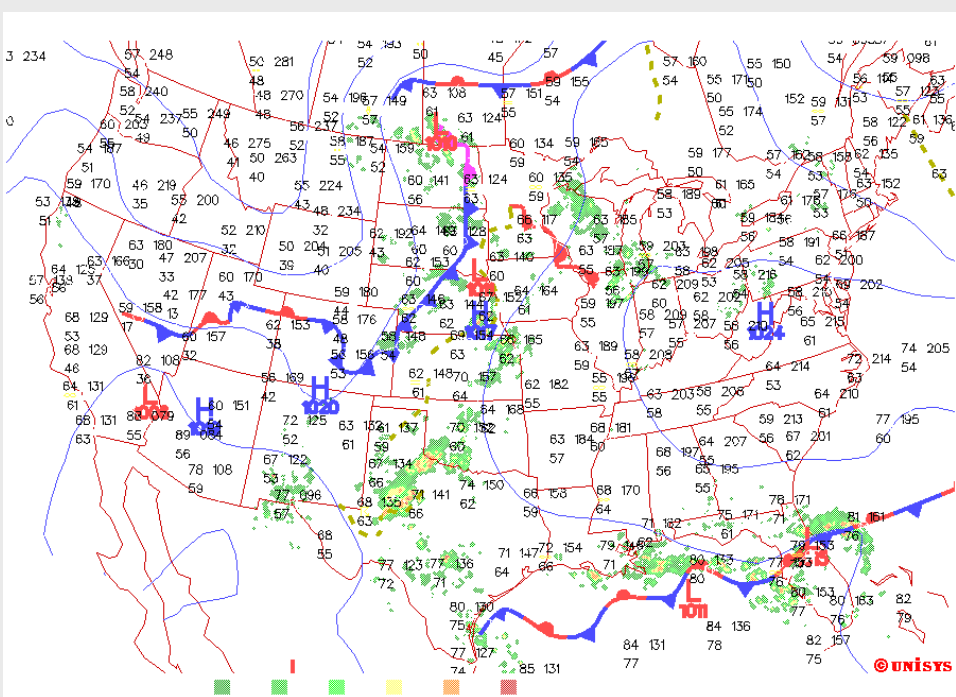
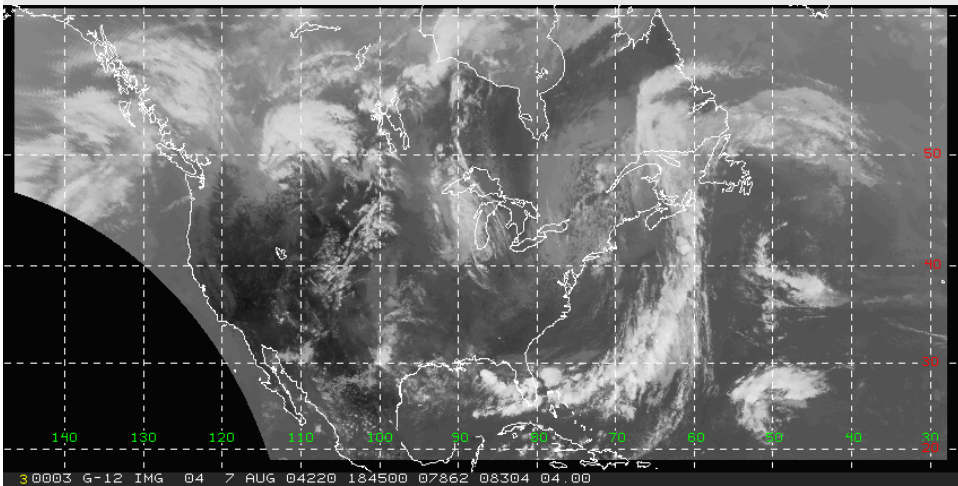
# Aug 6



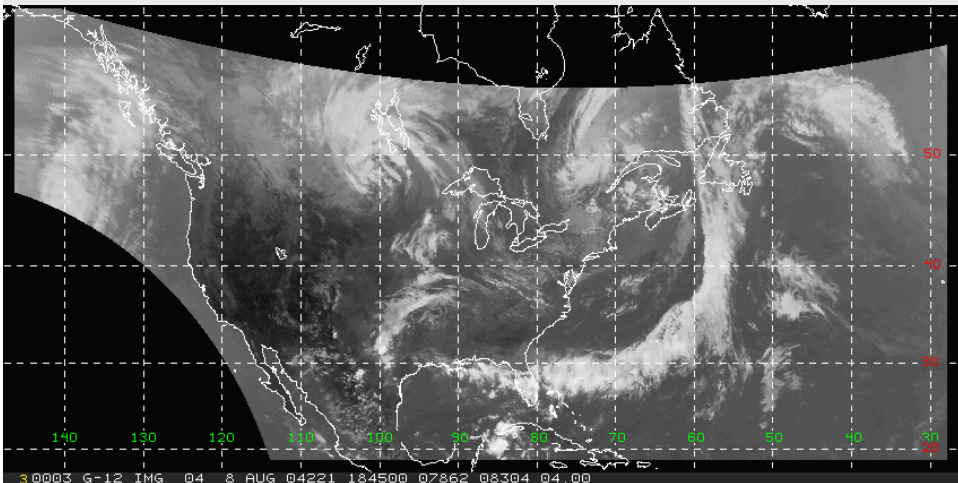




Aug 7

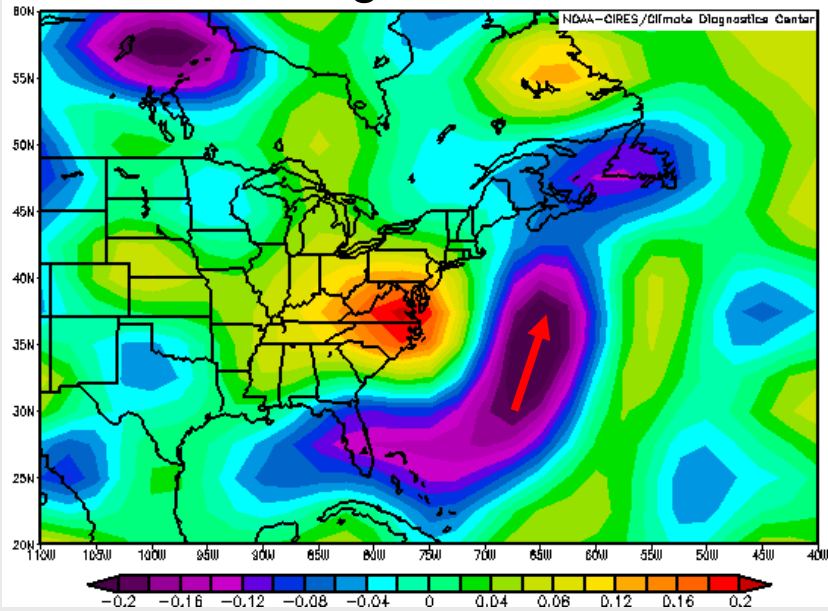


Aug 8

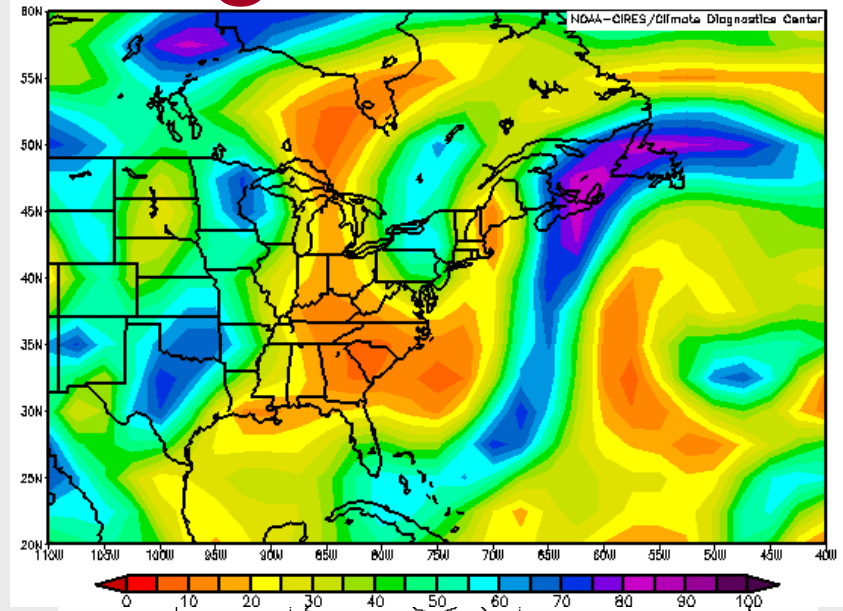


# Focus on Aug 7

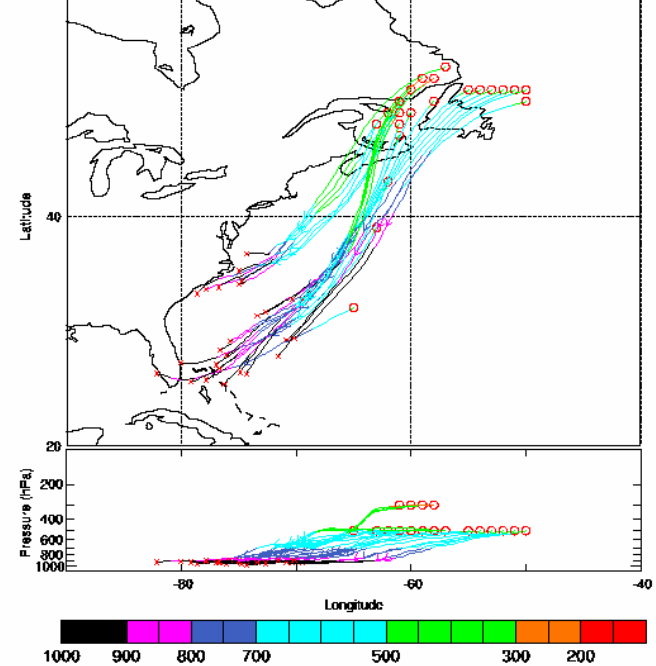
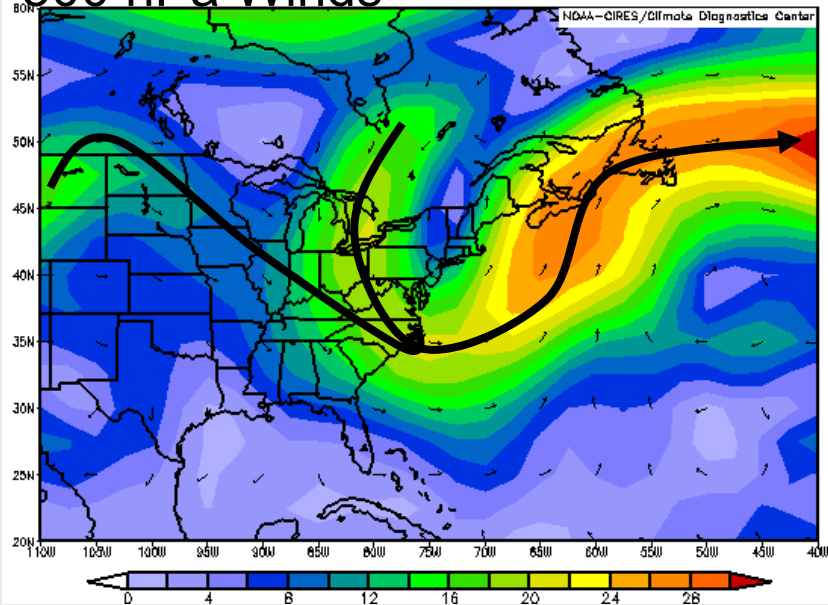
## 700 hPa Omega



## 500 hPa RH



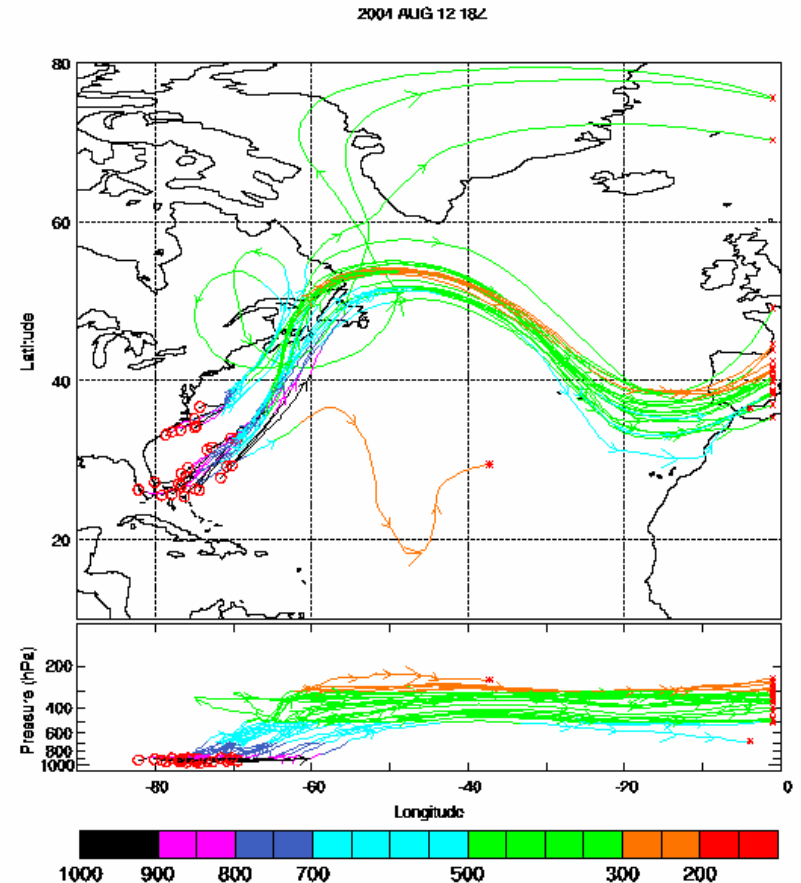
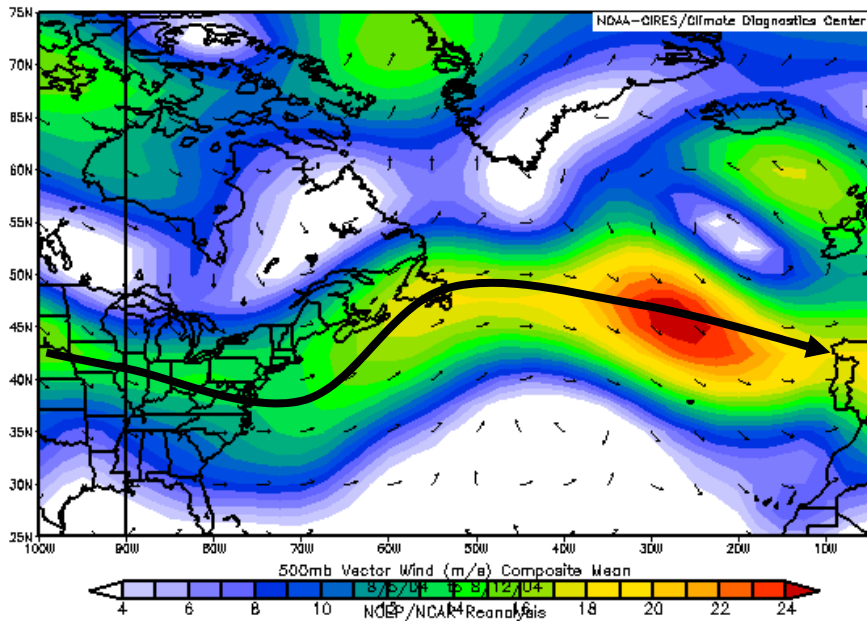
## 500 hPa Winds



# Focus on Aug 7

Boundary layer air transported in a direct path to Europe

## 500 hPa Winds



# Concluding Thoughts

- Wave cyclones fairly common throughout INTEx period.
- No cyclones deeper than 1000 hPa. Classical definition based on much stronger lows.
- Initial analyses identify some airstreams resembling WCBs.
- Some southerly flows not WCBs.
- Look forward to collaborating with AIRS and STEM to more fully understand CO transport and its depiction by AIRS.